Learning for a Better Safety and Security Culture Within an Organization: Reducing the Risk in Communication with AI Coaching for Security Communication Through Cyberspace

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Abstract This chapter describes an extension of a safety culture within hospital organizations providing more transparency and acknowledgement of all actors, and in particular the parents. It contributes a model architecture to support a hospital to develop such an extended safety culture. It is illustrated for prevention of postpartum depression. Postpartum depression is a commonly known consequence of childbirth for both mothers and fathers. In this research, we computationally analyze the risk factors and lack of support received by fathers. Therefore, we use shared mental models to model the effects of poor and additional communication by healthcare practitioners to mitigate the development of postpartum depression in both the mother and the father. Both individual mental models and shared mental models are considered in the design of the computational model. The chapter illustrates the benefits of simple support for communication during childbirth, which has lasting

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effects, even outside the hospital. For the impact of additional communication, a Virtual Safety Coach is designed that intervenes when necessary to provide support, i.e., when a health care practitioner doesn't. Moreover, organizational learning is also modelled to improve the mental models of both the Safety Coach and the Health Care Practitioner.

Keywords Shared mental models · Virtual AI-Coach in healthcare · Fathers/psychology · Depressive disorders/complications · Postpartum depression

1 Introduction

Learning is an integral part of organizations. Therefore, organizational learning (Kim 1997), has been coined as a key concept, as it facilitates further development, both within individuals, and as a result, within teams and organizations. This can lead to better governance and an adequate safety culture, also known as 'safety culture' or 'just culture'. The term refers to a culture within an organization that promotes open communication, transparency, and trust amongst the practitioners in any field (Solomon 2016). It is a tool to facilitate organizational learning.

In a healthcare organization, healthcare practitioners from multiple disciplines form healthcare teams, who strive to ensure the safety of patients. These teams coordinate and communicate throughout a certain medical procedure in a very cohesive manner to avoid all the risks that can be associated with healthcare. Moreover, these institutions maintain stability by following the protocols related to their medical procedures, and therefore, often these protocols are evaluated and modified to ensure patient safety (Crossan et al. 1999). For instance, childbirth is a sensitive and a daily occurring natural phenomenon in hospitals, that follows certain protocol or procedure. In a protocol like this, there are steps in place, for before, during and after, that healthcare practitioners must follow to ensure a safe and healthy delivery of the child. The main aim is to keep the mother and the baby safe during the whole process of delivery.

Safety culture encompasses realizing omissions and mistakes and not being scrutinized for the mistake or omission but instead learning from it. Practitioner-patient communication is a valuable step that can result in improved therapeutic outcomes (Hassan 2018). However, most of the time, delivery protocols are only in place for processes and changes or deviations in processes that may occur for the baby or the mother (Taal 2022). They fail to consider the possible adverse effects that may happen to the other-half or the family of a neonate. Bedside manners are within the curriculum of medical studies; however, the importance of adequate patient communication is often underestimated and, often considered to be a less valued step, and sometimes even a forgotten step, within the protocol. A lack of communication with both the mother and partner can result in feelings of isolation. Moreover, the different situational roles of parents and health care practitioners (HCPs) does not allow for open communication. This barrier is a factor that may develop mental health problems

in parents, such as postpartum depression (PPD) (Goodman 2004). Much attention is paid to PPD of mothers. However, there is very less attention for paternal postpartum depression (Goodman 2004). The feeling of isolation often contributes to paternal postpartum depression (PPPD), since fathers are not the active actors during the childbirth process, and little attention is awarded to them during the process. PPPD is accompanied by adverse effects affecting both the mother and the child. This chapter discusses methods that could facilitate better support for a father with the aim of decreasing the frequency of fathers experiencing mental health issues (Goodman 2004, 2008).

In this chapter, we use computational models to discuss (a) how a deviation in the childbirth process may lead to poor communication towards the parent(s). Also, we present (b) how a virtual safety coach can facilitate the healthcare practitioners for effective communication with parents in the context of childbirth process. Lastly, we address (c) how organizational learning can play its role in improving the mental models underlying communication. A virtual AI Coach can also help health practitioners to keep the parents intact (i.e., psychologically and socially) during the whole process. The designed models encompass protocols with common knowledge for all actors involved, as well as their own individual knowledge. The research focuses on reducing paternal postpartum depression and illustrates the positive influence this has on maternal postpartum depression. So, we present ways to encourage open and adequate communication both from the father's side and the healthcare practitioner's side. The aim is to expand the definition of safety culture, to involve not only the medical practitioners but also the patients and their families by improved communication. In return, this implementation depicts the benefits of open communication and its subsequent effect of decreasing the risk of both the mother and father developing PPD (Goodman 2004). For more detailed references see Sect. 2.

2 Background Literature

In this section, we present the background literature of our work. We will discuss the risk factors for maternal postpartum depression (Mayers et al. 2020), together with their consequences (Rao et al. 2020). Then we explain risk factors for paternal postpartum depression along with possible outcomes (Goodman 2008). We will also discuss how postpartum depression can be prevented (Dennis 2004; Smythe et al. 2022). Specifically, how paternal postpartum depression can be prevented, which in return has significant influence on reducing maternal postpartum depression. Moreover, we will discuss how computational causal modelling can play its role preventing the related risks.

2.1 Maternal Postpartum Depression and the Related Risk Factors

The ICD-10 states that "in typical mild, moderate, or severe depressive episodes, the patient suffers from lowering of mood, reduction of energy, and decrease in activity. Capacity for enjoyment, interest, and concentration is reduced, and marked tiredness after even minimum effort is common" (World Health Organization 1993). Postpartum depression refers to "mild mental and behavioural disorders associated with the puerperium" (World Health Organization 1993). In industrialized countries 10–15% of women experience major depressive episodes after giving birth (Maternal mental health and child health and development in resource-constrained settings, 2009, January 1). This statistic encompasses women with prior and without prior mental health issues. The phenomena of developing depression after childbirth, known as maternal postpartum depression (MPPD), is among the most common mental health consequences. Determining causes, possible interventions and creating support systems for new mothers suffering from PPD is at the forefront of postnatal care research (Garthus-Niegel et al. 2022; Mayers et al. 2020; Rao et al. 2020), as it may prevail for extended periods (Rao et al. 2020; Smythe et al. 2022).

Reasons for postpartum depression include obstetric factors, psychological factors, biological factors, social factors and lifestyle (Abenova et al. 2022; Javaid et al. 2022). Women who are nulliparous generally benefit from technically oriented support such as help with breastfeeding. On the other hand, multiparous women require more mental support, as they are at a higher risk of developing PPD, due to the additional stress of having another child at home (Dunkel Schetter et al. 2016). Another factor is the risk of the birth, especially when doctors must deviate from the original birth plan. A deviation from normal protocol results in a higher risk of the mother developing PPD. Similarly, deviating (having a caesarean section) from the mothers' desires (having a natural birth), has the same effect (Ghaedrahmati et al. 2017). The mode of delivery also influences the risk of developing PPD, with a natural birth being the safest option (Silverman et al. 2017). In addition, although it is a highly debated topic, the use of epidurals has been identified to decrease the chances of mothers developing PPD (Ghaedrahmati et al. 2017). Amongst all other factors, age also plays a role. Women who are 35 years or older are at a higher risk of developing PPD. The lowest risk is for women between the ages of 25 and 29 (Silverman et al. 2017). The age factor pertains to the fact, that the riskiness of the birth is higher for the prior (Cavazos-Rehg et al. 2015). Lastly, a mother-to-be is 4–18 times more likely to develop PPD if their child is born underweight (<1500 g) (Ghaedrahmati et al. 2017).

In addition to the factors mentioned above, social factors must be acknowledged to decrease the risk of a mother developing PPD. The social network around the woman is the most important aspect regarding support. "Newly expecting mothers perceive their partner as their main support system" (Mayers et al. 2020; Smythe et al. 2022). Their partners often see signs of change and act upon them, to ensure the woman receives the necessary mental health support.

2.2 *Consequences Beyond the Mother of Postpartum Depression*

Mothers suffering from postpartum depression receive a great amount of attention, as the negative correlation between a mother's mental health and a child's development is widely known (Cerezo et al. 2008; Goodman 2008). However, the spillover effect onto their partners is often not addressed. At the same time, father's support has been proven to benefit a mother's mental health (Goodman 2004). "Maternal depression was identified as the strongest predictor of paternal depression during the postpartum period" (Goodman 2004). 25% of women who experience PPD have a partner who is also experiencing PPD (Goodman 2008). Paternal postpartum depression is not a commonly known consequences of childbirth, as the attention, support and communication are directed towards the mother. This inequality in mental health services provided to mothers and fathers, results in fathers reporting feelings of isolation following childbirth. Most notably, this is prevalent following a traumatic birth, or simply a deviation from the original birth plan. This isolation creates insecurity and confusion for the fathers regarding their role (Mayers et al. 2020).

2.2.1 Paternal Postpartum Depression

The responsibility of a child can be overwhelming and intimidating. Moreover, childbirth is an intense experience for both mother and father. However, while mothers are fully involved and sufficiently supported, fathers often don't get the same treatment (Goodman 2004). The lack of paternal support received, increases the difficulty, both technically and mentally, of having a child. This results in a high chance of fathers developing postpartum depression (Goodman 2004, 2008).

While most partners feel as though the mother should be receiving most of the attention, the extreme imbalance between the information available to them and information available to mothers is not justified (Mayers et al. 2020). Fathers feel as though they should be given or offered more support and information than what is currently the norm. Additionally, the quality of mental health support has been criticized. "Fathers require better recognition of their mental health needs from healthcare professionals" (Mayers et al. 2020).

Societal stigma often results in the fathers not seeking for help, as they are meant to be the providers of the family and don't allow themselves to suffer mentally. Moreover, as fathers are not briefed on PPPD, they often don't see the signs and only accept the truth when it's too late for early intervention. Similarly, women may see a change in their partner. However, they do not have the priming of it potentially being PPD and therefore ignore the signs (Abenova et al. 2022).

The chances of paternal postpartum depression increase with unexpected childbirth, as a change of procedure while in the delivery room can be traumatizing for the father. The fear that develops in their minds, when there is no proper communication between healthcare personnel and the father in the delivery room causes

the fathers to think of the worst possible outcomes (Pedersen et al. 2021). A lack of support and communication from healthcare practitioners directly to the partners, results in a sensation of helplessness, isolation, and confusion regarding the partners mental health issues (Melrose 2010). Similarly to maternal PPD, paternal postpartum depression not only affects the father but also the mother and the child's development (Goodman 2004, 2008; Rohde et al. 2005).

2.2.2 Consequences of Paternal Postpartum Depression

Positive parent-infant interaction is the key to ensuring children's good psychological, cognitive and language development. Partners of women who suffer from PPD experience higher parenting stress, which results in less optimal father-infant interaction (Goodman 2008). In other words, parent-infant interaction is highly influenced by the mental well-being of the parents. Similarly, another study indicated that PPPD might have important implications on the family's mental health and wellbeing. A high correlation was found between the depression of one partner with another, producing significantly adverse effects on the other partner and child (Goodman 2004). Moreover, a study indicated that children of fathers with PPPD reported increased emotional and psychological issues (Rohde et al. 2005).

Depression is also sometimes termed as 'a preventable killer', because inadequate handling such psychiatric disorders may lead to the death of a partner, making the situation more complex (Biebel and Alikhan 2018; Kenyon 2015; Mayers et al. 2020). To ensure prosperity for a child's future life, hospitals should aim to identify signs of possible development of PPD in mothers and fathers. Moreover, they try to restore mental health as soon as possible (Melrose 2010). Tackling perinatal mental health support can reap long-term benefits for both the parents and the child (Mayers et al. 2020).

2.3 What Can Be Done More to Prevent Postpartum Depression

A study by Mayers et al. (2020) quoted fathers on their experiences and desires after childbirth.

> I read the information my wife was given.
>
> It didn't cover anything about the father and I felt lost.
>
> Leaflets on what to look out for, as you can't always remember what you are told in the immediate aftermath.
>
> Some Mental Health support, as well as social worker support and referral to a therapist.

> [I] had not given birth so had no cause for sympathy. A leaflet for my wife and a page for the fathers to read which wasn't enough (Mayers et al. 2020).

Partners of new mothers have expressed the need to a better understanding on how they can support the new mothers, as well as themselves. Specifically, clear communication and information regarding treatment and medication, to help the women, as well as to ease their own concerns. Currently, there is not enough support or information provided, and in the cases where support is given, the quality on average, is very low (Mayers et al. 2020). Due to the social stigma of a man's role in society, as well as the pressure of having to be a protector and a provider, fathers have expressed reservations about joining groups for support (Darwin et al. 2017). Darwin et al. concluded that fathers are reluctant and unable to seek help, as they "question the legitimacy of their experiences" and believe that the woman should have priority, especially when they perceive the facilities to help with mental health are under-resourced (Darwin et al. 2017). A further issue raised, was that verbally communicated information was often forgotten, especially when this information was relayed during a stressful time (Mayers et al. 2020).

Fathers have expressed their desire to receive information regarding postnatal mental illness (Pedersen et al. 2021), having someone to talk to, and direct healthcare service support that is specifically targeted towards them. The provided support currently does not seem enough, specifically in deviations that may happen during the process (Taal 2022), which in return diminishes the ability to support themselves and the mother properly. A simple solution given by a father could be "any offer of help and support" (Mayers et al. 2020). The opportunity to have someone to talk to was regarded as being very valuable, as well as simply being acknowledged. A referral to a therapist or social worker was suggested (Mayers et al. 2020).

Moreover, a standard agreed-upon method of receiving information for fathers would be in the form of readily available leaflets or various other types of written materials, as they would be easily accessible at any point in time. Emphasis was assigned to the helpfulness of having written material depicting other men's experience. This made them "realize you're not in the boat by yourself" (Darwin et al. 2017). The areas that are generally lacking within the support services are informational support and aftercare. "Early interventions to help fathers cope with stress may be needed to reduce the risk of future deterioration of emotional wellbeing" (Mayers et al. 2020; Pedersen et al. 2021).

3 Conceptual Analysis of Underlying Processes and Means to Model Them

This section presents the preliminary analysis of the underlying process that will be considered for modelling the communication and learning behavior for the safety coach, health practitioner and parents (addressed in Sect. 4). So, firstly (in Sect. 3.1), we explain the safety culture in the context of a parent seeking help and support during

the procedure. Secondly (in Sect. 3.2), we explain how organizational learning can play a role in encouraging communication during the process of childbirth. Lastly, we explain the role of the mental models in Sect. 3.3, along with the cognitive architecture used to model them and the learning of them.

3.1 Safety Culture

A good safety culture facilitates learning. Safety culture encompasses realizing omissions and mistakes, realizing that one may not fully be at fault, admitting to the errors and not being scrutinized for the error, but instead learning from it. Applying a safety culture creates an open environment for further development. It decreases the frequency of errors since individuals are willing to admit to them, instead of trying to cover up which may worsen the situation (Darwin et al. 2017). Facilities, which would benefit greatly from integrating a just safety culture, are hospitals. "A blame-free, nonpunitive culture encourages clinicians to report errors and truly learn from their mistakes. It also supports organizations in efforts to better understand their errors and make improvements" (Beyea 2004). The basis of this is founded on open communication with the goal of moving away from extreme punishment or a blameless culture and instead moving towards a just culture (Boysen 2013). The scope of this chapter doesn't refer to just safety culture in the classical sense, which encompasses a medical professional speaking up to avoid immediate medical mistakes. Still, it addresses just safety culture by the father's willingness to speak up and ask for support. The awareness that all actors inside the delivery room, including medical professionals and parents, are complex beings with desires and that they possess an understanding of what is needed to ensure overall success and health, is essential (Smythe et al. 2022). In addition, the understanding and acknowledgement that the actions currently taken may not be sufficient in some cases holds similar importance. Although the action of asking for support communication itself is not an active preventative measure, the resulting support serves as a tool to avoid possible long-term mental-health consequences (Kenyon 2015; Mayers et al. 2020). This perspective aims to bridge the gap between mental and physical health and emotional health, as they are not only independent of each other, but also dependent on each other (Pinto-Foltz and Logsdon 2008). By expanding the view of the involved actors, it allows for a more well-rounded approach with various points of view and an ever-increasing just safety culture (Darwin et al. 2017; Hassan 2018; Ratnapalan and Uleryk 2014).

This approach to safety culture has the ability to extend the range of the benefits from short-term to long-term. Communication is not strictly a medical step; if a mistake occurs, it expresses itself in direct consequences. However, it should be considered a valuable medical step, as it entails a simple skill that all individuals know, and can prevent consequences that aren't immediate, but can get visible in the long term (Hassan 2018). The goal is to encourage the implementation of a well-rounded treatment where the effects don't stop when one leaves the hospital.

3.2 Organizational Learning

Crossan et al. define organizational learning as:

> a dynamic process. Not only does learning occur over time and across levels, but it also creates a tension between assimilating new learning (feed forward) and exploiting or using what has already been learned (feedback). Through feed-forward processes, new ideas and actions flow from the individual to the group to the organization levels. At the same time, what has already been learned feeds back from the organization to group and individual levels, affecting how people act and think (Crossan et al. 1999).
>
> Feed forward relates to exploration. It is the transference of learning from individuals and groups through to the learning that becomes embedded-or institutionalized-in the form of systems, structures, strategies, and procedures (Hedberg 1981; Shrivastava 1983). Feedback relates to exploitation and to the way in which institutionalized learning affects individuals and groups (Crossan et al. 1999).

The four I's of organizational learning are intuiting, interpreting, integrating, and institutionalizing. The first two relate to an individual, the second and third to a team or group and the third and last to an organization (Crossan et al. 1999). These overlaps are links between the levels. For organization learning to occur, the understanding that an "organization operates in an open system, rather than having a solely internal focus" (Crossan et al. 1999) is crucial. In other words, there is a transfer of knowledge between individuals, groups and organizations (Kim 1997). According to Peter Senge's theory successful learning has the capacity to change and manage change, where an organization can adopt system thinking, shared mental models and shared vision can help learn in teams (Ratnapalan and Uleryk 2014).

3.3 Mental Models

Mental models are at the base of an individual's actions. Kim describes them as follows:

> Mental models represent a person's view of the world, including explicit and implicit understandings. Mental models provide the context in which to view and interpret new material, and they determine how stored information is relevant to a given situation (Kim 1997).

Interesting to note is the similarity between the two I's for individuals mentioned earlier and Kim's definition of mental models. The definition encompasses both 'intuiting' ('a person's view of the world, including explicit and implicit understandings') and 'interpreting' ('interpret new material'). Mental models are useful for individuals to create internal simulations based on certain circumstances. Moreover, new mental models or additions or revisions to mental models can be learned. This is encompassed by Piaget, who assigns importance to the marriage of accommodation (adapting ones individual internal concepts based on experiences) and assimilation (integrating ones experiences into ones individual internal concepts) as the keys to learning (Kim 1997; Piaget 1970).

Shared mental models are various mental models that ideally align themselves in a manner that they become shared knowledge. Therefore, their representation may not only rely on differential knowledge of a member, but they may also represent an overlap or convergence among their mental models in relation to a task or procedure. As shared mental models are related to a mutual goal, it relies mainly on understanding requirements and steps taken during a procedure. They can be equated to the third I, 'integrating'. Integrating refers to a shared understanding and mutual adjustment, creating interactive systems (Crossan et al. 1999). To facilitate integration, interpretation must be done by the means of communication (Bouma et al. 2022).

3.4 Cognitive Architecture Used for Shared Mental Models

Network-Oriented Modelling is a technique that can be used to model interconnected and interactive causal processes that are temporal by nature (Treur 2016). Given the direct relation between dynamics and causal relations, as highlighted in Treur (2016), this classical approach is extended to contain the notion of dynamics in a network structure. These notions of causality and dynamics have been incorporated and are part of a more refined structure and semantics of the considered networks. More specifically, the nodes in a network are interpreted here as states (or state variables) that vary over time, and the connections are interpreted as causal relations that define how each state can affect other states over time. To acknowledge this perspective of dynamics and causality on networks, this type of network has been called a temporal-causal network (Treur 2016).

Temporal-causal networks are the foundation of dynamic Network-Oriented Modelling. While the popular approach of causal modelling comes with limitations, the addition of dynamic features provides a more detailed and truthful representation of the real-world (Treur 2016). This dynamic perspective is based on a continuous time dimension, represented by real numbers. The temporal dimension enables modelling by cyclic causal networks as well, and also timing of causal effects can be modelled in detail. Due to this, causal reasoning and simulation is possible for networks that inherently contain cycles, such as networks modeling mental or brain states, or networks describing social interaction (Treur 2016).

The research conducted for this chapter is performed addressing mental processes using internal mental models, which are modeled in a network-oriented manner (see Treur 2016, 2020). It encompasses a social structure, depicting how people interact amongst themselves, as well as network structures that depict an individual's mental processes, in this case also including internal mental models, (Treur and Van Ments 2022), see also Van Ments et al. (2025), this volume. These models can also be used to reflect adaptive organizational behavior (Canbaloğlu et al. 2022), see also Canbaloğlu et al. (2022), this volume. In this technique, a network can be represented by a labelled graph containing states, also known as nodes, where each state X is connected to another state Y and where X has a causal impact on Y, at a certain

time, with some strength and speed. A, a temporal-causal network is characterized by Treur (2016):

Connectivity characteristics:
Connections from a state X to a state Y and their weights $\boldsymbol{\omega}_{X,Y}$.

Aggregation characteristics:
For any state Y, some combination function $\mathbf{c}_Y(\ldots)$ defines the aggregation that is applied to the single causal impacts $\boldsymbol{\omega}_{X,Y}X(t)$ on Y from its incoming connections from states X.

Timing characteristics:
Each state Y has a speed factor $\boldsymbol{\eta}_Y$ defining how fast it changes for a given causal impact.

The related difference Eq. (1) incorporates these characteristics in a standard numerical format (Treur 2016), i.e.:

$$Y(t+\Delta t) = Y(t) + \boldsymbol{\eta}_Y[\mathbf{c}_Y\left(\boldsymbol{\omega}_{X_1,Y}X_1(t), \ldots, \boldsymbol{\omega}_{X_k,Y}X_k(t)\right) - Y(t)]\Delta t \qquad (1)$$

Numerous combination functions are available to address the issue of aggregating multiple impacts (Treur 2016). Those which were used for this research are shown in Table 1.

The modelling of adaptive networks is based on network reification (or self-modeling network), which entails extending the base model by reification states, also referred to as self-model states. Reification is defined as "representing something abstract as a material or concrete thing, or making something abstract more concrete or real" (Treur 2020). The self-model states are part of a higher order adaptation and are visually placed on a higher plane than the base level. Similar to how the base level can be adaptive, the first reification level, also known as first-order self-model, can also be adaptive by nature. Therefore, the higher-order adaptive levels are not limited to one, as the construction can be iterated indefinitely. Network reification for a temporal-causal network means that for the adaptive network structure characteristics $\boldsymbol{\omega}_{X,Y}$, $\mathbf{c}_Y(\ldots)$, $\boldsymbol{\eta}_Y$ for each state Y of the base network, additional network states $\mathbf{W}_{X,Y}$, $\mathbf{C}_Y$, $\mathbf{H}_Y$ (called reification states) are introduced respectively (Treur 2020). Different simulating environments are used to simulate the (shared) mental models

Table 1 Combination functions used in the self-modelling network model

	Notation	Formula	Parameters
Advanced logistic sum	$\mathbf{alogistic}_{\sigma,\tau}(V_1, \ldots, V_k)$	$\left[\frac{1}{1+e^{-\sigma(V_1+\cdots+V_k-\tau)}} - \frac{1}{1+e^{\sigma\tau}}\right](1+e^{-\sigma\tau})$	Steepness σ Excitability threshold τ
Step once	$\mathbf{steponce}_{\alpha,\beta}(V)$	1 if $\alpha \le t \le \beta$ for time t, else 0	Start time α End time β
Monitor	$\mathbf{monitor}_{\tau}(V_1, V_2)$	1 if $V_1 - V_2 \ge \tau$, else 0	Activation threshold τ

in Matlab and Python. In Sect. 6, we explain how these characteristics can be used to simulate a model in Python.

In Treur (2021), Hendrikse et al. (2023), it is shown that any smooth dynamical system has a canonical representation as a temporal-causal network and any smooth (multi-order) adaptive dynamical system has a canonical representation as a (multi-order) self-modeling temporal-causal network. Therefore, compared to adaptive dynamical systems in general, the network-oriented modeling approach used here does not introduce any fundamental limitations concerning what it can model. This has also been confirmed by applications to case studies in practice, e.g., for mental models in Treur and Van Ments (2022) and for organizational learning in Canbaloğlu et al. (2025).

4 The Designed Network Model

The model discussed in this chapter focuses on childbirth at a hospital, where the father is constantly present in the delivery room, even in circumstances where a deviation from a standard protocol may happen (Taal 2022). It mainly encompasses the communication process starting shortly before childbirth and ending once the parents leave the hospital. The majority of the states in the model reflect communication actions, specifically geared towards the father. The communication process may (or may not) take place during and after childbirth, even in circumstances where a deviation can occur.

The research described in this chapter extends to two levels of adaptation (two self-modelling levels) on top of the base level. Therefore, in Sect. 4.1, we present the base model, which shows the model. In Sect. 4.2, we add the adaption level through self-modelling network and the role of a healthcare practitioner and a virtual safety coach (AIC). Lastly, in Sect. 4.3, we present how organization learning can influence the learning of the safety coach. Please note that the model presented in the following sections are mainly related to the communication between the healthcare practitioner (HCP) and the father of a neonate during the process of childbirth.

4.1 Base Level of the Adaptive Network Model

The base level, depicted in Fig. 1 (yellow parallelogram), contains the world states and the mental model of the healthcare practitioner (HCP). The world states in the base level of the model can be one of five types: process states (yellow), context states (orange), emotion states (red), paternal states (light orange), or communication action states (dark yellow).

The process states define both the baby being delivered and then subsequently, for example hours or days, after birth, as well as the risk of developing maternal postpartum depression, the risk of developing paternal postpartum depression and

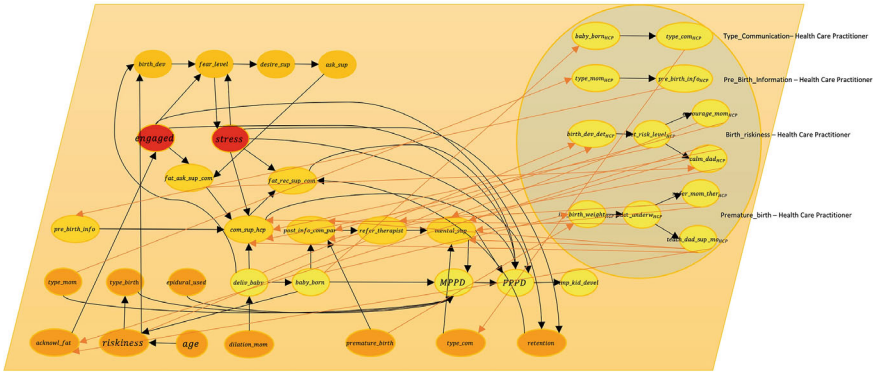


Fig. 1 Connectivity of the base model of the childbirth process

the risk of impending child development. The context states influence the process states, the emotion states and in some circumstances other context states. The emotion states represent the emotions of the actors that occur during childbirth which influence frequent communication. The paternal states indicate the process through which the father may go before reaching out for help. Lastly, the central part, the communication action states, depict the interaction between HCP and parents, specifically the father, throughout the childbirth process. The states were created based on the findings explained in Sect. 2 of this chapter. The connectivity of the base model can be seen in Fig. 1, while the detailed description of the states of the base level is enlisted in Table 2.

The mental model (light grey oval) of the HCP in the base level of the model shows which internal simulations a HCP can have during the childbirth process. There are four separate process models within the mental model, each with end states (bold), that connect to one of the communication actions and/or context states in the world states.

1. The baby is born, which affects the **type of communication** used
2. The type of mother, whether she is nulliparous or multiparous, determines whether any **special information has to be communicated before childbirth**. In the interest of space, type of mother is shortened to type of mom in the figures and tables.
3. The HCP determines that there is a deviation in the childbirth process. They determine the risk level associated with this deviation and, in return, **encourage the mother** while **calming the father**.
4. When the baby is born, especially if born prematurely, the HCP assumes the possibility of irregular birth weight of the child. Once the child is classified as being underweight, they **refer the mother to a therapist** and **teach the father how to support the mother**.

Table 2 Base level states (including HCP Mental Model)

State Number	State Name	Explanation	Level
X_1	type_mom	Pre-Birth: Determining whether the mother is nulliparous (first child) or multiparous (already has 1+ child)	Base Level
X_2	artificiality_birth	Pre-Birth: Determining the naturality of the birth: natural birth or caesarean section	
X_3	epidural_used	Pre-Birth: Determining if an epidural will be administered	
X_4	deliv_baby	Intra-Birth: Delivery of the baby; the woman is in labour	
X_5	baby_born	Post-Birth: The baby is born	
X_6	MPPD	Post-Birth: The risk of maternal postpartum depression	
X_7	PPPD	Post-Birth: The risk of paternal postpartum depression	
X_8	imp_kid_devel	Post-Birth: The risk of impeding child flourishing/development	
X_9	pre_birth_info	Pre-Birth: Information given to parents	
X_{10}	com_sup_hcp	Intra-Birth: Communication from HCP to parents	
X_{11}	fat_ask_sup_com	Intra-Birth: Father asks HCP for support communication	
X_{12}	fat_rec_sup_com	Intra-Birth: Father receives support communication from HCP	
X_{13}	post_info_com_par	Post-Birth: Information given to parents	
X_{14}	refer_therapist	Post-Birth: Referall by HCP of parent(s) to a therapist	
X_{15}	mental_sup	Post-Birth: Recieve additional mental support	
X_{16}	acknowl_fat	Acknowledgement of the father as an actor in childbirth by HCP	
X_{17}	age	Age of mother: whether she is between the ages of 25-29 or not	
X_{18}	riskiness	Riskiness of giving birth for the mother	
X_{19}	dilation_mom	Dilation of the mother	
X_{20}	premature_birth	Premature birth	
X_{21}	type_com	Type of commuication received/used: verbal or written	
X_{22}	retention	Ability to retain information received	
X_{23}	engaged	Level of active engagement	
X_{24}	stress	Level of stress	
X_{25}	birth_dev	Deviation from original birth plan	
X_{26}	fear_level	Level of fear	
X_{27}	desire_sup	Desire for support	
X_{28}	ask_sup	Willingness to ask for support	
X_{29}	birth_dev_det$_{HCP}$	Intra-Birth: Detecting a birth deviation	Base Level - HCP Mental Model
X_{30}	det_risk_level$_{HCP}$	Intra-Birth: Determining the risk of a given birth deviation	
X_{31}	encourage_mom$_{HCP}$	Intra- & Post-Birth: Encouraging the mother positively	
X_{32}	calm_dad$_{HCP}$	Intra- & Post-Birth: Calming the father	
X_{33}	irr_birth_weight$_{HCP}$	Post-Birth: Detecting irregular birth weight of the child	
X_{34}	det_underw$_{HCP}$	Post-Birth: Determining the child as underweight	
X_{35}	refer_mom_ther$_{HCP}$	Post-Birth: Referring the mother to a therapist	
X_{36}	teach_dad_sup_mom$_{HCP}$	Post-Birth: Teaching the father how to support the mother (techincally and mentally)	
X_{37}	baby_born$_{HCP}$	Post-Birth: The baby is born	
X_{38}	type_com$_{HCP}$	Type of commuication used: verbal or written	
X_{39}	type_mom$_{HCP}$	Pre-Birth: Determining whether the mother is nulliparous (first child) or multiparous (already has 1+ child)	
X_{40}	pre_birth_info$_{HCP}$	Pre-Birth: Giving information to parents	

4.2 First-Order Self-Model Level of the Adaptive Network Model

In this section, we present the first-order adaptive network level for the base model designed in Sect. 4.1. First-order adaptive networks model plasticity; changes in brain structure for learning through the 'Hebbian Learning' principle (Hebb 1949). First, we will discuss how HCP learns to communicate to the father by adding additional **W**-states on the first reification level, which determines the weight of the connection on the base level. Second, we present how a virtual safety coach (AIC) can facilitate communication using the shared mental models. Therefore, it has both **W**- and **H**-states on the first reification level. These states determine the weight of connections, and the speed factor of the connections on the base level, respectively. Third, we present how a virtual safety coach can monitor the communication during the procedure by adding both **W**-states and monitor states on the first reification level.

4.2.1 Healthcare Practitioner Learns to Communicate

Additionally, to the base level described above (see Sect. 4.1), Fig. 2, has a middle level (red parallelogram), to represent the first level or the self-model of the base model using reification level states. This level contains eight **W**-states (red), which represent the weight of the connections within the HCP mental model on the base level. The detailed description of these states can be found in Table 3.

4.2.2 The Role of the Virtual Safety Coach

This chapter aims to model and determine the usability and effectiveness in having a virtual AI Coach (AIC) present. The main goal of the coach is to reduce the risk of maternal and paternal postpartum depression. This coach is aware of deviations in the process of the communication actions, and may intervene to provide support to the health practitioner(s) to correct them. Thus the related actions can be in terms of altering the HCP of a forgotten action or communicating with the father itself (upon approval by an HCP). Thus, the Virtual AI Coach (AIC) will not only help the healthcare practitioner to monitor the process for communication, but also will facilitate them for communication, and in return avoiding adverse possible effects like PPPD and MPPD. Therefore, here, we present an extension to contain the Virtual AI Coach (Fig. 3) that intervenes when necessary in terms of communication with the father of the child. This was done by duplicating the mental model of the HCP for the Coach. The states, as well as all connections within the mental model and to the world states are identical.

The middle level was also duplicated, meaning eight **W**-states (green) were created to represent the weight of the connections within the Coach mental model. In addition,

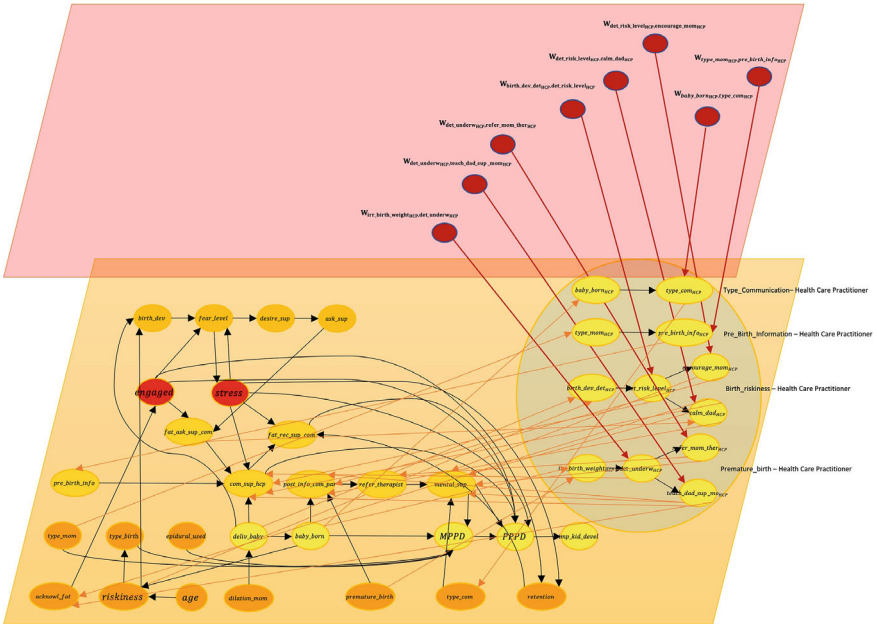


Fig. 2 Connectivity of first-order adaptive network model Case (a) first-order self-model states (or First Reification Level States)

seven new states were added to this level. Six of these additional states are **H**-states (green), which have connections to one of each of the end states within the Coach mental model. The **H**-states represent time activation of the end states and are controlled by the seventh state (blue), a context state that activates the Coach at a particular time. A detailed explanation of the additional states is given in Table 4.

4.2.3 Dynamic Monitoring by the Virtual Coach

To create a more dynamic Virtual Coach, a further model (Fig. 4) was created. The goal of this Coach is not to be activated by time; instead, we designed a 'monitor' function (see Table 1). This function is responsible for monitoring the communication and context states affected by the end states of the mental models. Therefore, if insufficient activation of those states is detected (through a parameter called threshold—$\boldsymbol{\tau}$) by the Coach, then the Coach activates the corresponding part of its mental model, which results in the Coach performing the communication action instead of the HCP.

This model of monitoring role of the virtual AI Coach differs in the number of nodes in the middle level. The 16 **W**-states representing the weight of the connections for both mental models in the base level persist. However, the seven additional states mentioned in Sect. 4.2.2 were removed. Instead, 14 new **W**-states (green) that represent the weight of connections were added. These states represent the

Table 3 Additional base level and first-order self-model states (or First Reification Level States)

State Number	State Name	Explanation	Level
X_{41}	$birth\_dev\_det_{AIC}$	Intra-Birth: Detecting a birth deviation	Base Level - AIC Mental Model
X_{42}	$det\_risk\_level_{AIC}$	Intra-Birth: Determining the risk of a given birth deviation	
X_{43}	$encourage\_mom_{AIC}$	Intra- & Post-Birth: Encouraging the mother positively	
X_{44}	$calm\_dad_{AIC}$	Intra- & Post-Birth: Calming the father	
X_{45}	$irr\_birth\_weight_{AIC}$	Post-Birth: Detecting irregular birth weight of the child	
X_{46}	det_underw_{AIC}	Post-Birth: Determining the child as underweight	
X_{47}	$refer\_mom\_ther_{AIC}$	Post-Birth: Referring the mother to a therapist	
X_{48}	$teach\_dad\_sup\_mom_{AIC}$	Post-Birth: Teaching the father how to support the mother (techincally and mentally)	
X_{49}	$baby\_born_{AIC}$	Post-Birth: The baby is born	
X_{50}	$type\_com_{AIC}$	Type of commuication used: verbal or written	
X_{51}	$type\_mom_{AIC}$	Pre-Birth: Determining whether the mother is nulliparous (first child) or multiparous (already has 1+ child)	
X_{52}	$pre\_birth\_info_{AIC}$	Pre-Birth: Giving information to parents	
X_{61}	$\mathbf{W}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	First reification level
X_{62}	$\mathbf{W}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	
X_{63}	$\mathbf{W}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	
X_{64}	$\mathbf{W}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	
X_{65}	$\mathbf{W}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	
X_{66}	$\mathbf{W}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	
X_{67}	$\mathbf{W}_{baby\_born\_AIC,\ type\_com\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{baby\_born\_AIC,\ type\_com\_AIC}$	
X_{68}	$\mathbf{W}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	Reified representation state for connection weight $\boldsymbol{\omega}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	
X_{69}	$\mathbf{H}_{encourage\_mom\_AIC}$	Reified representation state for speed factor $\eta_{encourage\_mom\_AIC}$	
X_{70}	$\mathbf{H}_{calm\_dad\_AIC}$	Reified representation state for speed factor $\eta_{calm\_dad\_AIC}$	
X_{71}	$\mathbf{H}_{refer\_mom\_ther\_AIC}$	Reified representation state for speed factor $\eta_{refer\_mom\_ther\_AIC}$	
X_{72}	$\mathbf{H}_{teach\_dad\_sup\_mom\_AIC}$	Reified representation state for speed factor $\eta_{teach\_dad\_sup\_mom\_AIC}$	
X_{73}	$\mathbf{H}_{type\_com\_AIC}$	Reified representation state for speed factor $\eta_{type\_com\_AIC}$	
X_{74}	$\mathbf{H}_{pre\_birth\_info\_AIC}$	Reified representation state for speed factor $\eta_{pre\_birth\_info\_AIC}$	
X_{75}	con_act_AIC	Context state for determining activation of the AIC	

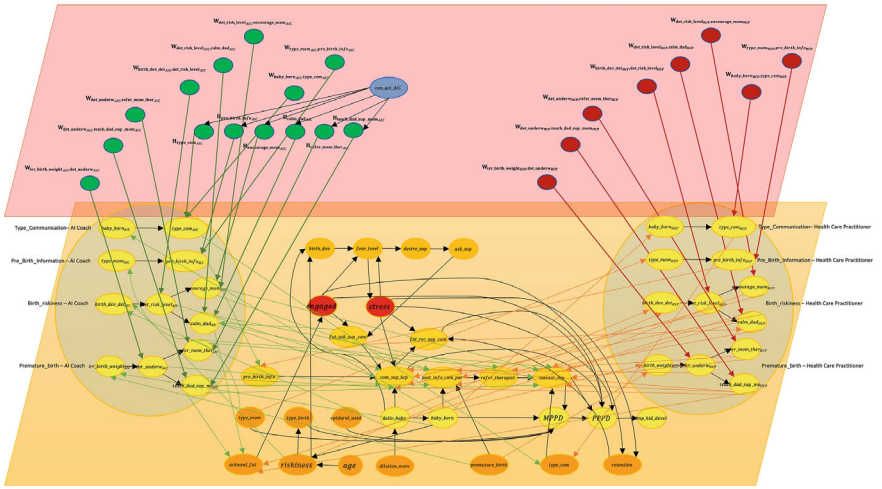


Fig. 3 Connectivity of first-order adaptive network model Case (b)

weight of connections between the end states of the mental model of the Virtual AI Coach and the world states affected by them. Moreover, 14 monitor states (blue), each with an outgoing connection to one of the new states mentioned earlier, were included that receive input from the base level and determine whether to activate their corresponding states based on the monitor combination function described in Table 1. A more in-depth explanation of the states in the middle level can be seen in Table 5.

4.3 Second-Order Self-Model Level—Organizational Learning (Feed Forward and Feedback)

The Second-Order Adaption Level adds another abstraction level of learning to the states modelled on first-order network using meta-plasticity principle. At this level, context states were added along with $\mathbf{W_W}$-states on the second reification level. It is to be noted that eight more $\mathbf{W}$ states are introduced on the first-order level in relation to organizational learning. This final addition to the model was done by incorporating an expert (Fig. 5) of the organization.

The goal with adding an expert (E) was to show the possibility of the Virtual AI Coach learning from a practitioner with a complete mental model. Moreover, the Coach, having acquired this knowledge, can then pass it on to the HCP. In this case the Coach's mental model is interpreted as a shared mental model. This creates a more adaptive Virtual Coach, as it allows for the constant addition of information from an expert (as feed forward learning). This information is then relayed (feedback

Table 4 Case (c) first-order self-model states (or First Reification Level States)

State Number	State Name	Explanation	Level
X_{53}	$W_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	Reified representation state for connection weight $\omega_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	First reification level
X_{54}	$W_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	Reified representation state for connection weight $\omega_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	
X_{55}	$W_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	Reified representation state for connection weight $\omega_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	
X_{56}	$W_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	Reified representation state for connection weight $\omega_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	
X_{57}	$W_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	Reified representation state for connection weight $\omega_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	
X_{58}	$W_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	Reified representation state for connection weight $\omega_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	
X_{59}	$W_{baby\_born\_HCP,\ type\_com\_HCP}$	Reified representation state for connection weight $\omega_{baby\_born\_HCP,\ type\_com\_HCP}$	
X_{60}	$W_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	Reified representation state for connection weight $\omega_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	
X_{61}	$W_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	Reified representation state for connection weight $\omega_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	
X_{62}	$W_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	Reified representation state for connection weight $\omega_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	
X_{63}	$W_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	Reified representation state for connection weight $\omega_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	
X_{64}	$W_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	Reified representation state for connection weight $\omega_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	
X_{65}	$W_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	Reified representation state for connection weight $\omega_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	
X_{66}	$W_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	Reified representation state for connection weight $\omega_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	
X_{67}	$W_{baby\_born\_AIC,\ type\_com\_AIC}$	Reified representation state for connection weight $\omega_{baby\_born\_AIC,\ type\_com\_AIC}$	
X_{68}	$W_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	Reified representation state for connection weight $\omega_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	
X_{69}	$W_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	Reified representation state for connection weight $\omega_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	
X_{70}	$W_{calm\_dad\_AIC,\ acknowl\_fat}$	Reified representation state for connection weight $\omega_{calm\_dad\_AIC,\ acknowl\_fat}$	
X_{71}	$W_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	Reified representation state for connection weight $\omega_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	
X_{72}	$W_{calm\_dad\_AIC,\ com\_sup\_hcp}$	Reified representation state for connection weight $\omega_{calm\_dad\_AIC,\ com\_sup\_hcp}$	
X_{73}	$W_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	Reified representation state for connection weight $\omega_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	
X_{74}	$W_{calm\_dad\_AIC,\ post\_info\_com\_par}$	Reified representation state for connection weight $\omega_{calm\_dad\_AIC,\ post\_info\_com\_par}$	
X_{75}	$W_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	Reified representation state for connection weight $\omega_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	
X_{76}	$W_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	Reified representation state for connection weight $\omega_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	
X_{77}	$W_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	Reified representation state for connection weight $\omega_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	
X_{78}	$W_{calm\_dad\_AIC,\ mental\_sup}$	Reified representation state for connection weight $\omega_{calm\_dad\_AIC,\ mental\_sup}$	
X_{79}	$W_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	Reified representation state for connection weight $\omega_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	
X_{80}	$W_{encourage\_mom\_AIC,\ mental\_sup}$	Reified representation state for connection weight $\omega_{encourage\_mom\_AIC,\ mental\_sup}$	
X_{81}	$W_{refer\_mom\_ther\_AIC,\ mental\_sup}$	Reified representation state for connection weight $\omega_{refer\_mom\_ther\_AIC,\ mental\_sup}$	
X_{82}	$W_{type\_com\_AIC,\ type\_com}$	Reified representation state for connection weight $\omega_{type\_com\_AIC,\ type\_com}$	
X_{83}	monitor_pre_birth_info	State monitoring AIC mental model state pre_birth_info_AIC and world state pre_birth_info	
X_{84}	monitor_acknowl_fat$_1$	State monitoring AIC mental model state teach_dad_sup_mom_AIC and world state acknowl_fat	
X_{85}	monitor_acknowl_fat$_2$	State monitoring AIC mental model state calm_dad_AIC and world state acknowl_fat	
X_{86}	monitor_com_sup_hcp$_1$	State monitoring AIC mental model state calm_dad_AIC and world state com_sup_hcp	
X_{87}	monitor_com_sup_hcp$_2$	State monitoring AIC mental model state teach_dad_sup_mom_AIC and world state com_sup_hcp	
X_{88}	monitor_post_info_com_par$_1$	State monitoring AIC mental model state encourage_mom_AIC and world state post_info_com_par	
X_{89}	monitor_post_info_com_par$_2$	State monitoring AIC mental model state calm_dad_AIC and world state post_info_com_par	
X_{90}	monitor_post_info_com_par$_3$	State monitoring AIC mental model state teach_dad_sup_mom_AIC and world state post_info_com_par	
X_{91}	monitor_refer_therapist	State monitoring AIC mental model state refer_mom_ther_AIC and world state refer_therapist	
X_{92}	monitor_mental_sup$_1$	State monitoring AIC mental model state encourage_mom_AIC and world state mental_sup	
X_{93}	monitor_mental_sup$_2$	State monitoring AIC mental model state refer_mom_ther_AIC and world state mental_sup	
X_{94}	monitor_mental_sup$_3$	State monitoring AIC mental model state calm_dad_AIC and world state mental_sup	
X_{95}	monitor_mental_sup$_4$	State monitoring AIC mental model state teach_dad_sup_mom_AIC and world state mental_sup	
X_{96}	monitor_type_com	State monitoring AIC mental model state type_com_AIC and world state type_com	

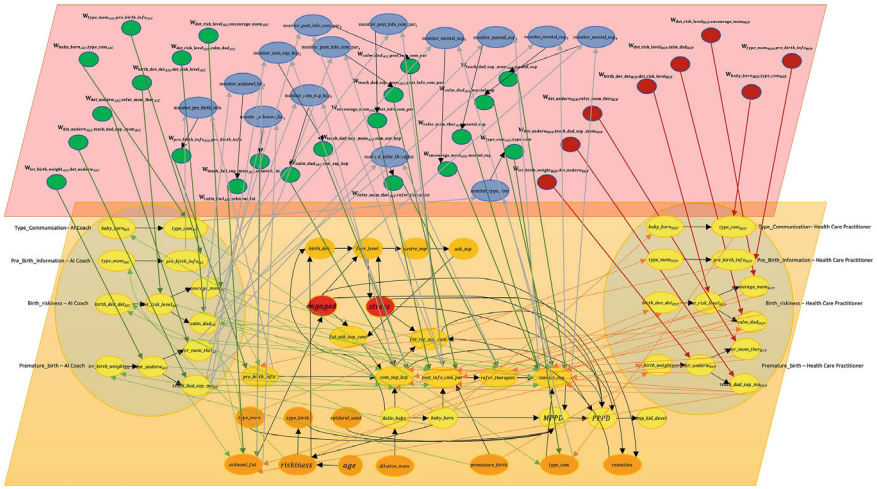


Fig. 4 Connectivity of first-order adaptive network model Case (c)

learning) to the HCPs after childbirth, making it an increasingly more valuable asset within a hospital setting and depicting organizational learning.

The set-up of the model is as follows. The base-level remains the same as in Sects. 4.2.2 and 4.2.3. The reason the expert is not being included in the actual process, is that he/she is a tool for teaching the Coach, while not being actively on the floor when the HCP and Coach work in cohesion. The middle level is the same as in Sect. 4.2.3, with the addition of eight **W**-states (purple) representing the knowledge of an expert. Each of these states has a link (light blue) from them to their counterpart of the eight original **W**-states corresponding to the Coach. Moreover, as the HCP can learn from the Coach, an additional eight links (light blue), with the same setup as mentioned before, were added from the Coach **W**-states to the HCP **W**-states.

In the second-order self-model level, two $\mathbf{W_W}$-states -states (dark blue) were included, as well as two context states (blue). The $\mathbf{W_W}$-states -states represent the horizontal connection weights (light blue) between the Expert (E) and the Coach, as well as between the Coach and Healthcare Practitioner (HCP). Therefore, the left most one has downward connections (dark blue) to the Coach **W**-states, and the right most one has downward connections (dark blue) to the HCP **W**-states. The context state con_feedforward creates an initial shared mental model of the knowledge necessary. The context state con_feedback updates the individual mental model, of the HCP in this case, with the information from the shared mental model. The detailed descriptions of the newly added states can be seen in Table 6.

Table 5 First- and second-order self-model states (or First and Second Reification Level States)

State Number	State Name	Explanation	Level
X_{97}	$\mathbf{W}_{\mathbf{W\_AIC,W\_HCP}}$	Reified representation state for connection weight $\boldsymbol{\omega}_{W\_AIC,W\_HCP}$ for the connection between the reified representation states X_{61}-X_{68} and X_{53}-X_{60}, respectively	Second reification level
X_{98}	con_feedback	Context state for learning of the HCP from the AIC	
X_{99}	$\mathbf{W}_{birth\_dev\_det\_E,\ det\_risk\_level\_E}$	Representation state for the experts knowledge about birth_dev_det_E, det_risk_level_E	First reification level
X_{100}	$\mathbf{W}_{det\_risk\_level\_E,\ encourage\_mom\_E}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_risk\_level\_E,\ encourage\_mom\_E}$	
X_{101}	$\mathbf{W}_{det\_risk\_level\_E,\ calm\_dad\_E}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_risk\_level\_E,\ calm\_dad\_E}$	
X_{102}	$\mathbf{W}_{irr\_birth\_weight\_E,\ det\_underw\_E}$	Reified representation state for connection weight $\boldsymbol{\omega}_{irr\_birth\_weight\_E,\ det\_underw\_E}$	
X_{103}	$\mathbf{W}_{det\_underw\_E,\ refer\_mom\_ther\_E}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_underw\_E,\ refer\_mom\_ther\_E}$	
X_{104}	$\mathbf{W}_{det\_underw\_E,\ teach\_dad\_sup\_mom\_E}$	Reified representation state for connection weight $\boldsymbol{\omega}_{det\_underw\_E,\ teach\_dad\_sup\_mom\_E}$	
X_{105}	$\mathbf{W}_{baby\_born\_E,\ type\_com\_E}$	Reified representation state for connection weight $\boldsymbol{\omega}_{baby\_born\_E,\ type\_com\_E}$	
X_{106}	$\mathbf{W}_{type\_mom\_E,\ pre\_birth\_info\_E}$	Reified representation state for connection weight $\boldsymbol{\omega}_{type\_mom\_E,\ pre\_birth\_info\_E}$	
X_{107}	$\mathbf{W}_{\mathbf{W\_E,W\_AIC}}$	Reified representation state for connection weight $\boldsymbol{\omega}_{W\_E,W\_AIC}$ for the connection between the reified representation states X_{99}-X_{106} and X_{61}-X_{68}, respectively	Second reification level
X_{108}	con_feedforward	Context state for learning of the AIC from the E	

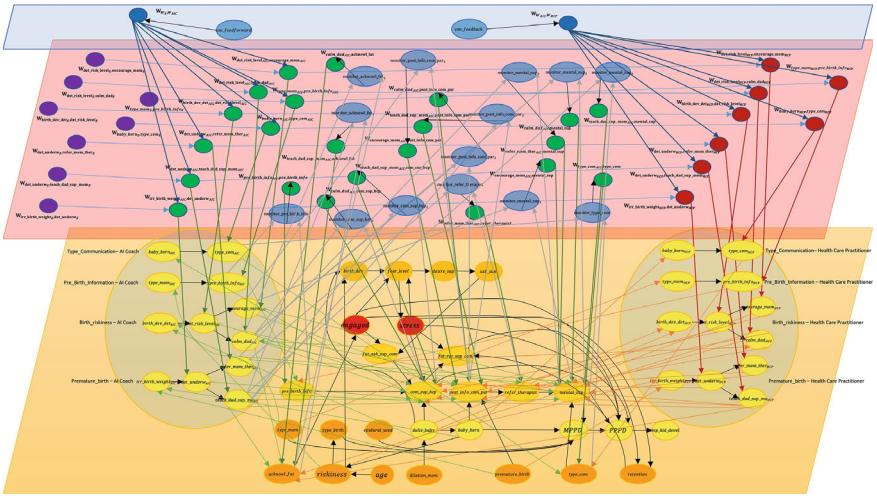


Fig. 5 Connectivity of second-order adaptive network model Case (d)

5 Simulation Results

This section presents the assumption made to simulate the model, along with the simulation results obtained from the designed model presented in Sect. 4.

5.1 Assumptions Considered for Simulation

While most states are dynamic, meaning they depend on the impact of other states, a handful of states within the models have manually chosen values given their binary nature.

1. The type of mother, either nulliparous or multiparous, was assigned a fixed value of 0, which corresponds to the mother being nulliparous.
2. The artificiality of birth, either being natural or caesarean section, was assigned a fixed value of 0, which corresponds to the mother having a natural birth.
3. The type of birth, either being no/little risk or high risk, was assigned a fixed value of 0, which corresponds to there being no risk.
4. The pre-birth information either being extra information is needed or not, was assigned a fixed value of 0, which corresponds to there being no need for additional information.
5. The age, either between the ages of 25–29 or not, was assigned a fixed value of 1, corresponding to the mother being between 25 and 29 years old.
6. Premature birth, either the birth being premature or not, was assigned a fixed value of 1, which corresponds to it being a premature birth.

Moreover, certain states had concrete specifications.

1. The starting value for maternal postpartum depression (MPPD) was set at 0.13, which is median of the probability of a woman developing postpartum depression (p. 526—Dennis 2004)
2. The state for dilation of the mother increases and reaches a maximum at 0.8, which represents full dilation of 10 cm (NHS 2020).
3. Once the dilation of the mother reaches 0.8, the state 'baby_born' is activated and increases quickly to 1 (Hueston 1998).

The time points (t) are referred to as unit time and have a value range between 0 and 80. This range for t is selected for an impression. However, it can also have a different range, and can be interpreted in minutes or hours. Moreover, the choice that a deviation occurs during childbirth, as well as the birth being premature, was deliberate, to show the effects of proper communication in a scenario where complications arise. In addition, the mother was set up with the best conditions to not develop MPPD. This can be seen by a slower increase of the line in the simulations compared to PPPD.

Furthermore, an active mental model is defined by the end states of the four mental processes specified earlier (See Sect. 4). Meaning all states, except the end states, may be active, as there is internal knowledge of what is occurring in front of them. However, this does not result in further communication actions. For example, the HCP is aware of there being a birth deviation but does not follow through with the further steps that then elicit the communication action.

Lastly, since the goal of this chapter is to observe and show how to reduce the risk of maternal (light blue) and paternal (red) postpartum depression and in return reducing the risk of impeding child development (dark blue), their corresponding lines were made bold.

5.2 Communication with the Parents

5.2.1 Adequate Communication Between Healthcare Practitioners and Parents

Here, we present a scenario of successful communication between parents and Healthcare Practitioner (HCP) during the childbirth process. The time duration is from 0 to 40 (t-axis) with a step size of $\Delta t = 0.1$. The low step size results in smoother curves in the simulation graphs.

At first, the healthcare practitioner is set to have a perfect mental model (all HCP's **W**-states are constant 1). The simulation shown in Fig. 6 depicts this scenario. The trend lines of the three bold states first increase since a deviation occurs, and risk and fear persist. However, once adequate support from the HCP to the father sets in, there is a fast decrease, eventually reaching 0. MPPD also decreases, as a result

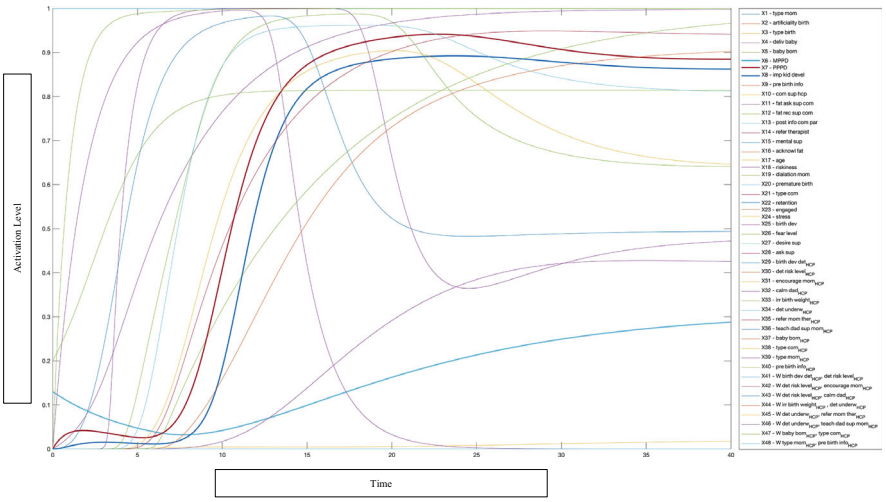


Fig. 6 Simulation results for successful communication between HCP and parents of the child

of the risk of PPPD decreasing, since the father being healthy allows for adequate support of the mother.

5.2.2 Ineffective Communication Between HealthCare Practitioners and Parents

In comparison to the simulation above, a further scenario was simulated (Fig. 7) to show the effects of imperfect communication of the HCP. When performing this simulation, all values were kept the same, except for the values of states in the mental model of the HCP. In this simulation, the HCP does not have an active mental model that facilitates proper communication (all HCP's **W**-states are constant 0).

When comparing Figs. 6 and 7, one can clearly see the effects of a lack of communication support from the HCP to the parents. While in Fig. 6, all risk-representing bold states increase, but promptly decrease again to reach 0, in Fig. 7, they all depict only an increase. At roughly $t = 25$, PPPD and imp_kid_devel correct themselves once the risk factor has subsided but remain high until the end of the time span. Moreover, MPPD has a steadily increasing trend, with no indication of decreasing whatsoever.

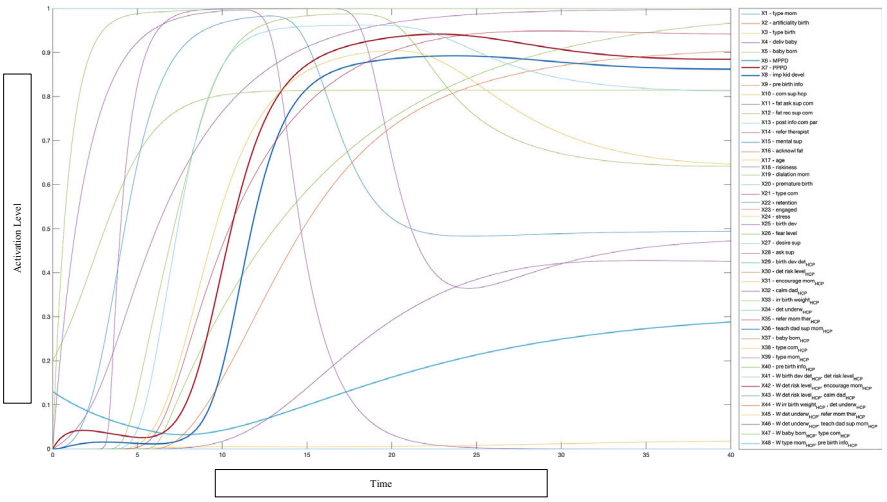


Fig. 7 Simulation results for poor communication between the HCP and the parents

5.3 The Role of the Virtual Coach

In this scenario, the virtual AI Coach (AIC) steps in to communicate when a healthcare practitioner doesn't attend to the father and mother appropriately during childbirth. The simulation (Fig. 8) has a time duration from 0 to 60 (t-axis) with a step size of $\Delta t = 0.1$. An increase of the time duration, in comparison to previous simulation (see Sect. 5.2), compensates for the late activation of the communication actions.

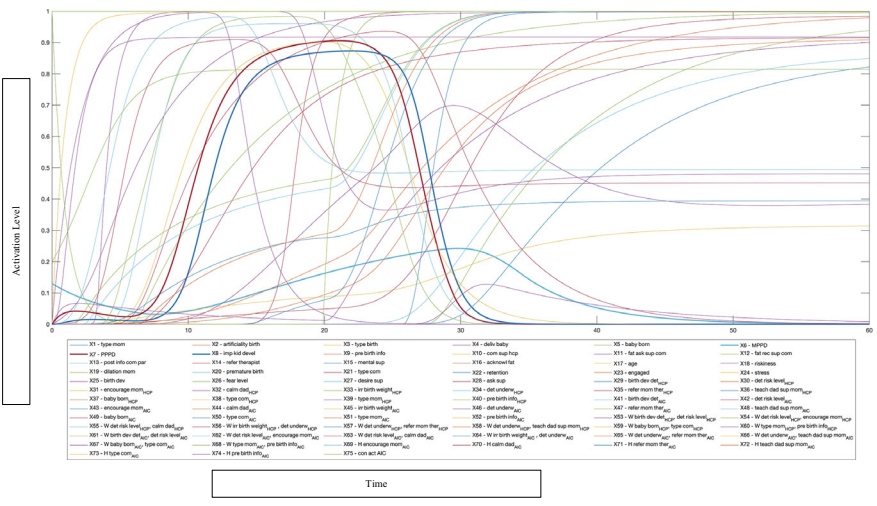


Fig. 8 Simulation results for Case (b)—AIC intervenes

The end states of the HCP never get activated and remain at 0, which results in no communication taking place from the HCP's side. This is due to the fact that the **W**-states are at 0 for the HCP. There exists an exception to this rule, as the calm_dad_HCP state gets activatedbriefly upon the fat_ask_sup_com state. Given the father approaching a HCP to ask for support, the HCP will act on being approached, even if their own initiative isn't there. This is visible by the two purple lines that reach their maximum at around $t = 30$.

On the other hand, the **W**-states for the AIC are at 1, meaning the respective mental model is active. The intervention (con_act_AIC) of the AIC starts at $t = 20$ (red line). The rapid change from 0 to 1 of this state, consequently, affects the communication action mental model states of the AIC. Before $t = 20$ these states had a slow increasing trend with little effect on the PPPD, MPPD and imp_kid_devel states. Promptly after the intervention, a rapid growth of the trend lines of the AIC mental model end states can be observed. This is a result of the **H**-states (purple line). This activation of the mental model translates into real-world support, which prompts, amongst others, the desire_sup state to decrease. The effects of this intervention can be observed by the three bold trend lines, which change course to decrease at around $t = 24$. Simultaneously to the end states of the AIC mental model reaching 1, the risk of PPPD and the risk of imp_kid_devel reach 0, followed by the risk of MPPD shortly after.

6 Dynamic Context-Sensitive Monitoring by the Virtual Coach

This is a similar scenario where a healthcare practitioner doesn't attend to the father and mother appropriately during the childbirth process. However, here, the Coach acts in a more context-sensitive manner. It is actively monitoring the relevant world states and intervenes only when it doesn't detect enough activation. The simulation (Fig. 9) has a time duration from 0 to 60 (t-axis) with a step size of $\Delta t = 0.1$.

Similarly to the role of the coach (discussed in Sects. 4.2.2 and 5.3), the HCP mental model does not get activated for the same reasons (**W**-states constant 0). Moreover, the **W**-states for AIC are also the same (constant 1). The reason for them being 1 is because the AI Coach is supposed to have perfect knowledge from the beginning. The mental model of the AIC is active starting between $t = 0$ to $t = 12$. The interesting aspect about this model are the monitoring states. These activate in the range of $t = 15$ to $t = 20$, as well as from $t = 35$ to $t = 48$.

Taking type_com (red line at $t = 20$) as an example state, the sequences of how the monitors activate will be explained. State type_com_AIC (blue line at $t = 17$), which is the mental model state of the AIC for the type of communication, activates first, since the AI Coach has a perfect mental model. This is followed by the monitor_

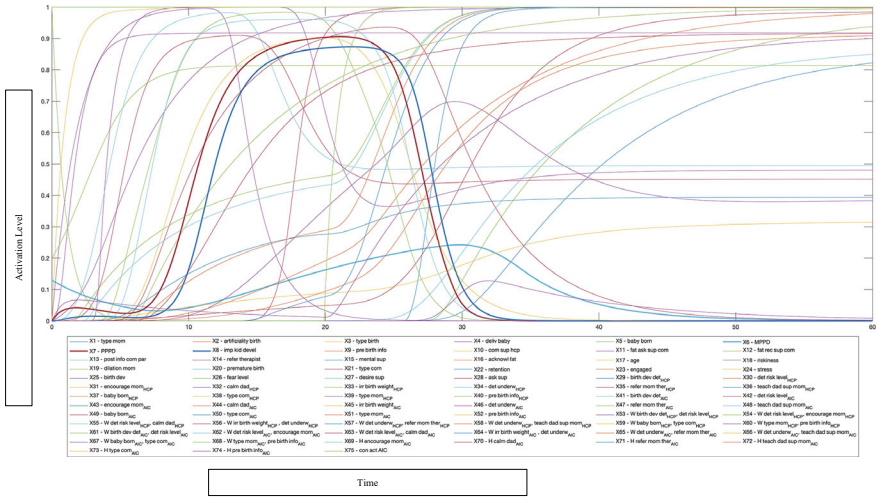


Fig. 9 Simulation results for Case (c)—AIC monitors

type_com (green high spike at $t = 20$) state, which in return activates W_type_com_AIC, type_com (green low spike at $t = 20$) to effectuate the communication intended by AIC. The process that occurs here is that the monitor state observes the type_com and type_com_AIC states and, by applying the monitor function (see Table 1), determines whether it must act to compensate for missing actions in the real world. This occurs by strengthening the W_type_com_AIC, type_com connection weight state. As a result of the strengthening, the type_com context state gets activated, which means it is being translated into a real-world action: the communication from the AIC actually takes place.

The overall time-span for the bold lines to decrease and eventually reach zero is higher than in the previous two cases, however the same outcome is eventually reached. This is a result of the increased duration due to the monitoring having to take place before the AIC can act. The speed factors for the AIC were chosen this way to make it not too fast, as it would be a disadvantage if the HCP didn't have time to start acting, before the AIC stepped in.

6.1 The Role of Organizational Learning

In this scenario, a healthcare practitioner initially has no knowledge for the appropriate mental model and doesn't attend to the father and mother appropriately during the childbirth process. However, in this case, we present the process of organizational learning by which HCP would improve its mental model, by acquiring shared knowledge. In this case, the AI Coach get on the role of maintaining the organization's shared mental knowledge. It acquires it first by feed forward learning. This

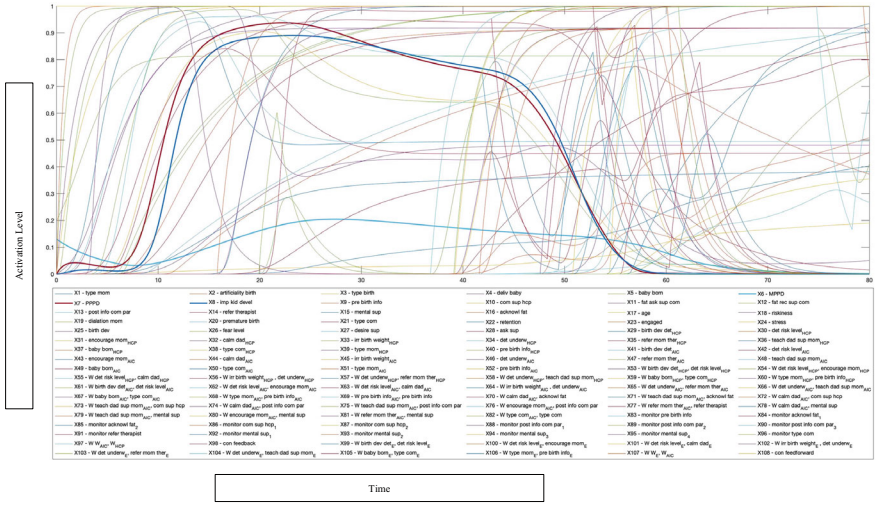


Fig. 10 Simulation results for Case (d)—expert teaches AIC, AIC monitors, AIC teaches HCP

is based on an expert teaching the AI Coach, thus creating a shared mental model. Then later in the process feedback learning takes place: this shared mental model is transferred to HCP (after the childbirth process). In this way, this simulation depicts organizational learning. The timing was a deliberate choice, as teaching the HCP during childbirth could result in increased stress levels and, in return, possibly have an adverse effect on the communication actions. Similar to our previous simulation results (Sect. 5), the AI Coach uses monitors to determine if or when to take an action. The simulation (Fig. 10) has a time duration from 0 to 80 (t-axis) with a step size of $\Delta t = 0.1$. The increased time duration is to have a full illustration of the learning phase of the HCP after the childbirth process.

This scenario follows a similar trend as dynamic monitoring (Sect. 5), given that the HCP has a non-active mental model. Meaning the actions that take place to reduce the three bold line states are identical to what is described above. The notable difference is the learning of the AIC from the expert. The left most line represents the $\mathbf{W_W}$-states of the expert to the AIC (light red), which strengthens the connection weights, meaning the AIC acquires all the information and a shared mental model has been established. Moreover, the learning of the HCP from the AIC is activated by the con_feedback state (purple) at $t = 40$. At around $t = 48$, the $\mathbf{W_W}$-states (light blue) of the AIC to the HCP begin to increase. This activates the $\mathbf{W}$-states of the HCP and in return strengthens the mental model connection weights. The HCP learns between $t = 50$ and $t = 60$.

7 An Environment for the Virtual Safety Coach

The models designed and simulated in this study explain how using a Virtual Safety Coach can improve communication among healthcare practitioner and father. The Virtual AI Coach will be designed to use these models, with the aim to facilitate the medical practitioners to achieve their goals without any possible omission or other error. In other words, the Safety Coach would mainly rely on similar mental models to facilitate the healthcare practitioners.

In network models, states and their causal relations are declarative by nature and can be represented by some connection weight, speed, and a combination function values (see Sects. 3.3 and 3.4). These values are used to compute the impact of a state by the incoming states. In particular, a combination function is responsible to compute the effect of the incoming states(s), which may vary as per the nature of the combination function used for them. To reflect various behaviors different functions ranging from simple standard functions like Euclidian (i.e., eucl(V)) to more complex ones like homophily (i.e., slhomo(V_1,V_2,W)) were designed (Treur 2016, 2020). We created a library, that offers these combination functions at one place. This library can be extended further, to reflect more behaviors, which have not been addressed before. Thus the library can be considered as a collection of various functions along with information describing them, for example:

```
Library{
id,                    // unique identifier of the combination function
name,                  // the name of the function
numberOfParams,        //number of possible parameters
params                 //names of the parameters

}
```

The combination functions included in the library follows a template.

$$\mathrm{cf}_i\big(i, (p_1, p_2, \ldots, p_j), (V_1, \ldots, V_k)\big)$$

In principle, a state may have a number $k \geq 0$ of incoming causal connections. Also, a combination function in the library may have j parameters ($j = 0 \ldots m$). For instance, the identity function does not take any parameter. However, a logistic homophily function takes three parameters. Detailed information related to combination function is available online (Treur 2019). Moreover, a state is considered as a specification that can be defined as:

```
State{
initialValue,
speedFactor,
connectionWeight,
output,
cfData
}
```

For all state data (e.g., initialValue, speedFactor, weights), values range from 0 to 1, while output reflects the output of a state, that varies according to the causal

impact of input states with respect to the time t. This output is computed using a combination function structured under the variable called 'cfData'. This consists of:

- **ImpactWeight**: How strong a specific combination function influences a state.
- **Parameters**: This contains the values of the parameters for the combination function used.

It is to be noted, that ImpactWeight facilitates the modelers to use different combination functions to study behaviors that are hybrid by nature. An example can be a state X which gets activated after a certain period of time, and show the behavior through **alogistic** function. In this case, a modeler can use **step** functions to reflect the period along with the alogistic function, with different impact weights for both functions (where the sum of impact weights should be 1). Parameters contain the value for the parameters used with respect to a combination function during the simulation, which is also addressed in the literature (Treur 2019). Please note, parameters may vary as per combination function used for a state. The simulation environment takes input with respect to each state. Therefore, for simulation, we provide the state specification. For instance, each state Y will have.

- list of incoming connections to state Y (e.g., states $X_1, X_2,\ldots,X_n$)
- the connection weight of each incoming state (e.g., from state $X_1, X_2,\ldots,X_n$)
- the speed of influence of the incoming states (termed as $\boldsymbol{\eta}_Y$)
- initial value (iv_Y)
- cfData (cf_Y).

This input is processed to generate the simulation output. For each state, this output is computed by the formula mentioned in Eq. (1). Therefore, '*output*' is a matrix containing timestamps and values for all the states of a model with their respective timestamps. Therefore, *output* not only reflects the state value at a certain time, but it also provide reasoning for the causal interaction between the states, which can be viewed by different plotting methods. Built-in plot methods were used to generate the simulation results of the designed model, which can be viewed in Appendix B.

8 Discussion and Conclusion

This study presents adaptive computational network models covering (shared) mental models of the father and healthcare practitioner, which illustrates how they can communicate during childbirth (Weigl et al, 2023). These models are designed using multidisciplinary literature. Therefore, first, the benefits of the HCP having a mental model for communication is presented. Then it shows the utility of a Virtual Safety Coach (AIC) intervening after a given amount of time, to compensate for actions not being taken by the healthcare practitioner. This study also presents an advanced

version of the Coach, illustrating a more complex system using monitoring for determining whether the Coach performs communication or not. Simulation results indicate that integrating the partners into the childbirth process and viewing them as active actors, as well as opening up communication lines between HCP and parents', aids in decreasing the risk of postpartum depression and in return ensuring positive child development. Moreover, both communication actions by AIC and HCP carry the same weight. This indicates that both are equally as effective in reaching the same end goal of having no risk of the father developing PPD.

Although the father is considered an actor, the mental model of the father was not included, as the AI Coach is a tool for HCP's and therefore, the father's internal model would have added no additional useful information to the simulations and in return, to the real-life application. However, in monitoring action of the safety coach, the willingness of the father to speak up alone, elicited a reaction in the mental model of the HCP. Therefore, promoting and applying a just safety culture into hospital organizations, where all parties involved feel welcome to speak up, has a lasting effect on the overall learning. This stems from the fact, that repeated and increasing exposure to the stimulus of the HCP being asked for support communication accelerates adaptation and can lead to long-term learning (Robinson et al. 2016). Similar to the safety culture, organizational learning allows for an ever-evolving growth of knowledge and creates stronger foundations for new and current HCPs in the medical field. This was reflected by using the notion of feedforward and feedback in the study. Applying the Virtual Safety Coach into the field and treating it as an individual reaps the benefits of using it to create a shared mental model based on the mental models existing within experts and, through this further education and improvement in medical practices. The combination of various mental models to create a shared mental model, results in optimal current knowledge.

Lastly, the strong influence of proper communication depicted in the models is not limited to the potential they depict of communication within the childbirth process. The perspective can be extended to other medical practices, which increasingly facilitates a safety culture, where open communication lies at the center.

9 Limitations and Further Work

This research has potential limitations. Given the nature of the research focusing mainly on actions that can be taken to reduce paternal postpartum depression, overcompensation may be a factor. Specifically, the bias of centering the model around necessary communication for father, may have restricted the realistic scope of the communication actions for the mother while assigning too much emphasis on those actions for the father only.

During modeling, various aspects were not discussed, for instance, how communication may influence the stress or engagement levels, while considering all the actors. Similarly, how communication can play its role in overcoming the related

fears is not addressed. During simulation we only presented for a certain time duration, but, it would be interesting to investigate the impacts of communication for a longer time, i.e., when parents leave the hospital. Moreover, how equilibrium for certain states (e.g., stress or asking for support), may influence states of postpartum depression for longer time is not presented in this study.

The available literature on risk factors and intervention methods to combat paternal postpartum depression is not very extensive. Some states selected for the model are based on desires that fathers have expressed without their effectiveness being studied scientifically and determined to be successful. In future, we aim to collect more multidisciplinary information, which may help researchers to provide some analytical grounds to study the effectiveness of the modeled states. A possible improvement on this, could be conducting a study based on the Edinburgh Postpartum Depressive Scale (EPDS) and applying the values to the model created. The model is created in such a way, that does not depend on a precise definition, and it is not limited to one notion. This allows for a large application scope within the AI Coach Project.

Also, we aim to extend our model, in terms of responses of healthcare practitioners toward father and toward the virtual safety coach. In the future, we also would like to study multiple factors (e.g., culture, family structure or affiliations) regarding communication during the childbirth process (Dunkel Schetter et al. 2016; Goodman 2004). Moreover, an extension including the support during the prepartum period, would add to the effectiveness of communication in reducing the risk of postpartum depression. This stems from the fact, that developing depression is not limited to after giving birth. In addition, a relevant point that was not discussed in the scope of this chapter, is it could help parents who previously suffer from depressive episodes.

We also aim to extend the monitoring. Some world states had incoming connections from multiple mental model end states. In the models, this may have resulted in only one of these end states being activated, as one may be sufficient to pass the chosen threshold determining activation, which allows for some but not the maximum possible support.

Learning is a time-consuming task not only for individuals but also for the HCP and AIC. Therefore, in a real-world setting, this would allow for emphasis to be applied on having certain mental process over others. For example, having only post-birth communication may be as effective in decreasing the risk of PPPD as all the other states combined. This would allow for an adequate learning pace for practitioners in the field without overwhelming them regarding vast additional knowledge. Similarly, this could be applied to the AIC teaching the HCP in steps (based on importance), rather than all at once. By doing so, the level of retention of the information could be higher. Moreover, studying the aspect of trust towards AIC can also add a value while discussing the levels of communication.

In this study, the Coach (AIC) is modeled to be activated without a permission from the actors on the floor. To implement it with the current mental model into a healthcare setting, one would have to ensure high specificity and high sensitivity of the AIC. This would avoid eliciting negative emotions in the father with a false positive of, for example, a deviation occurring. A trigger initiated from the HCP could activate the Coach would be beneficial.

In the real-world, the virtual AI Coach can be considered a facility to assist healthcare practitioners. Therefore, the coach could have a different model (i.e., not similar to HCP). In this study, the virtual AI Coach is trying to monitor if communication is needed. That might be possible by analyzing the conversations or through some sensors. However, then the coach should be empathetic enough to provide support to the father. Moreover, without a trigger, it would be still questionable if the coach receives enough input to decide on whether to communicate or not in terms of accuracy and time. Lastly, how communication provided by Virtual Safety Coach will be evaluated by all the actors, is also to be considered as a future work for this research study.

Acknowledgements This research is part of the SAFECoach Project, which aims to create an AI based coach to serve hospital organization. The main aim of this coach is to assist healthcare practitioner while considering mental models and shared mental models for its implementation.

Appendix A: Role Matrices for all Model Variants

Role matrices are the numerical representations of the simulations. They provide full information about the network characteristics of the model variants. Below all role matrices for the models are visible, with each state having its own row, on which each incoming connections, as well as their impact, is specified. Moreover, they are color coordinated based on the level that the states lie on.

Communication

Health Care Practitioner Communicates with Father

See Tables 6, 7, 8, 9, 10 and 11.

Lack of Communication with Father

See Tables 12, 13, 14, 15, 16 and 17.

Role of Virtual Safety Coach

See Tables 18, 19, 20, 21, 22 and 23.

Table 6 Role matrix for best Case (a) for **mb**—base connectivity

mb - base connectivity		1	2	3	4	5	6	7	8
X_1	type_mom	X_1							
X_2	artificiality_birth	X_2	X_{18}						
X_3	epidural_used	X_3							
X_4	deliv_baby	X_4	X_{19}						
X_5	baby_born	X_4							
X_6	MPPD	X_1	X_2	X_3	X_5	X_{15}			
X_7	PPPD	X_6	X_{10}	X_{12}	X_{15}	X_{23}	X_{24}		
X_8	imp_kid_devel	X_7							
X_9	pre_birth_info	X_9	X_{40}						
X_{10}	com_sup_hcp	X_4	X_9	X_{11}	X_{24}	X_{30}	X_{32}	X_{34}	X_{36}
X_{11}	fat_ask_sup_com	X_{23}	X_{28}						
X_{12}	fat_rec_sup_com	X_{10}	X_{22}	X_{24}					
X_{13}	post_info_com_par	X_5	X_{20}	X_{31}	X_{32}	X_{36}			
X_{14}	refer_therapist	X_{13}	X_{35}						
X_{15}	mental_sup	X_{14}	X_{21}	X_{31}	X_{32}	X_{35}	X_{36}		
X_{16}	acknowl_fat	X_9	X_{32}	X_{36}					
X_{17}	age	X_{17}							
X_{18}	riskiness	X_5	X_{17}						
X_{19}	dilation_mom	X_{19}							
X_{20}	premature_birth	X_{20}							
X_{21}	type_com	X_{21}	X_{38}						
X_{22}	retention	X_{23}	X_{24}						
X_{23}	engaged	X_{16}							
X_{24}	stress	X_{26}							
X_{25}	birth_dev	X_4	X_{18}						
X_{26}	fear_level	X_{23}	X_{24}	X_{25}					
X_{27}	desire_sup	X_{26}							
X_{28}	ask_sup	X_{27}							
X_{29}	birth_dev_det$_{HCP}$	X_4	X_{18}						
X_{30}	det_risk_level$_{HCP}$	X_{29}							
X_{31}	encourage_mom$_{HCP}$	X_{30}							
X_{32}	calm_dad$_{HCP}$	X_{11}	X_{30}						
X_{33}	irr_birth_weight$_{HCP}$	X_5	X_{20}						
X_{34}	det_underw$_{HCP}$	X_{33}							
X_{35}	refer_mom_ther$_{HCP}$	X_{34}							
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{34}							
X_{37}	baby_born$_{HCP}$	X_5							
X_{38}	type_com$_{HCP}$	X_{37}							
X_{39}	type_mom$_{HCP}$	X_1							
X_{40}	pre_birth_info$_{HCP}$	X_{39}							
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	X_{41}							
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	X_{42}							
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	X_{43}							
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	X_{44}							
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	X_{45}							
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	X_{46}							
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	X_{47}							
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	X_{48}							

Dynamic Monitoring of Virtual Safety Coach

See Tables 24, 25, 26, 27, 28 and 29.

Table 7 Role matrix for best Case (a) for **mcw**—connection weights

mcw - connection weights		1	2	3	4	5	6	7	8
X_1	type_mom	1							
X_2	artificiality_birth	1	-1						
X_3	epidural_used	1							
X_4	deliv_baby	1	1						
X_5	baby_born	1							
X_6	MPPD	0.25	0.25	0.25	0.25	-1			
X_7	PPPD	1	-0.5	-0.5	-0.5	-0.5	1		
X_8	kid_devel	1							
X_9	pre_birth_info	1	1						
X_{10}	com_sup_hcp	1	1	1	-1	1	1	1	1
X_{11}	fat_ask_sup_com	1	1						
X_{12}	fat_rec_sup_com	1	1	-1					
X_{13}	post_info_com_par	1	1	1	1	1			
X_{14}	refer_therapist	1	1						
X_{15}	mental_sup	1	1	1	1	1	1		
X_{16}	acknowl_fat	1	1	1					
X_{17}	age	1							
X_{18}	riskiness	-1	1						
X_{19}	dilation_mom	1							
X_{20}	premature_birth	1							
X_{21}	type_com	1	1						
X_{22}	retention	2	-1						
X_{23}	engaged	1							
X_{24}	stress	1							
X_{25}	birth_dev	1	1						
X_{26}	fear_level	-1	1	1					
X_{27}	desire_sup	1							
X_{28}	ask_sup	1							
X_{29}	birth_dev_det$_{HCP}$	1	1						
X_{30}	det_risk_level$_{HCP}$	X_{41}							
X_{31}	encourage_mom$_{HCP}$	X_{42}							
X_{32}	calm_dad$_{HCP}$	1	X_{43}						
X_{33}	irr_birth_weight$_{HCP}$	1	2						
X_{34}	det_underw$_{HCP}$	X_{44}							
X_{35}	refer_mom_ther$_{HCP}$	X_{45}							
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{46}							
X_{37}	baby_born$_{HCP}$	1							
X_{38}	type_com$_{HCP}$	X_{47}							
X_{39}	type_mom$_{HCP}$	1							
X_{40}	pre_birth_info$_{HCP}$	X_{48}							
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1							
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1							
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1							
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1							
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1							
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1							
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1							
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1							

Organizational Learning and Its Influence

See Tables 30, 31, 32, 33, 34 and 35.

Table 8 Role matrix for best Case (a) for **mcfw**—combination function weights

mcfw - combination function weights		1
		Alogistic
X_1	type_mom	1
X_2	artificiality_birth	1
X_3	epidural_used	1
X_4	deliv_baby	1
X_5	baby_born	1
X_6	MPPD	1
X_7	PPPD	1
X_8	kid_devel	1
X_9	pre_birth_info	1
X_{10}	com_sup_hcp	1
X_{11}	fat_ask_sup_com	1
X_{12}	fat_rec_sup_com	1
X_{13}	post_info_com_par	1
X_{14}	refer_therapist	1
X_{15}	mental_sup	1
X_{16}	acknowl_fat	1
X_{17}	age	1
X_{18}	riskiness	1
X_{19}	dilation_mom	1
X_{20}	premature_birth	1
X_{21}	type_com	1
X_{22}	retention	1
X_{23}	engaged	1
X_{24}	stress	1
X_{25}	birth_dev	1
X_{26}	fear_level	1
X_{27}	desire_sup	1
X_{28}	ask_sup	1
X_{29}	$birth\_dev\_det_{HCP}$	1
X_{30}	$det\_risk\_level_{HCP}$	1
X_{31}	$encourage\_mom_{HCP}$	1
X_{32}	$calm\_dad_{HCP}$	1
X_{33}	$irr\_birth\_weight_{HCP}$	1
X_{34}	det_underw_{HCP}	1
X_{35}	$refer\_mom\_ther_{HCP}$	1
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	1
X_{37}	$baby\_born_{HCP}$	1
X_{38}	$type\_com_{HCP}$	1
X_{39}	$type\_mom_{HCP}$	1
X_{40}	$pre\_birth\_info_{HCP}$	1
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1

Table 9 Role matrix for best Case (a) for **mcfp**—combination function parameters

mcfp - combination function parameters		1 Alogistic	
		Steepness	Threshold
X_1	type_mom	50	0.5
X_2	artificiality_birth	50	0.5
X_3	epidural_used	50	0.5
X_4	deliv_baby	5	0.5
X_5	baby_born	50	0.5
X_6	MPPD	5	0.3
X_7	PPPD	5	0.5
X_8	kid_devel	5	0.5
X_9	pre_birth_info	50	0.5
X_{10}	com_sup_hcp	0.5	6
X_{11}	fat_ask_sup_com	5	1
X_{12}	fat_rec_sup_com	5	0.5
X_{13}	post_info_com_par	5	4
X_{14}	refer_therapist	5	1
X_{15}	mental_sup	5	5
X_{16}	acknowl_fat	5	0.8
X_{17}	age	5	0.5
X_{18}	riskiness	50	0.5
X_{19}	dilation_mom	2.8	0
X_{20}	premature_birth	5	0.5
X_{21}	type_com	5	0.1
X_{22}	retention	5	0.3
X_{23}	engaged	5	0.5
X_{24}	stress	5	0.5
X_{25}	birth_dev	50	1
X_{26}	fear_level	5	1
X_{27}	desire_sup	5	0.3
X_{28}	ask_sup	5	0.2
X_{29}	$\text{birth\_dev\_det}_{HCP}$	5	1
X_{30}	$\text{det\_risk\_level}_{HCP}$	5	0.5
X_{31}	$\text{encourage\_mom}_{HCP}$	5	0.5
X_{32}	calm_dad_{HCP}	50	0.7
X_{33}	$\text{irr\_birth\_weight}_{HCP}$	5	1
X_{34}	det_underw_{HCP}	5	0.5
X_{35}	$\text{refer\_mom\_ther}_{HCP}$	50	0.5
X_{36}	$\text{teach\_dad\_sup\_mom}_{HCP}$	50	0.7
X_{37}	baby_born_{HCP}	5	0.5
X_{38}	type_com_{HCP}	50	0.5
X_{39}	type_mom_{HCP}	5	0.5
X_{40}	$\text{pre\_birth\_info}_{HCP}$	50	0.5
X_{41}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	5	0.5
X_{42}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	5	0.5
X_{43}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	5	0.5
X_{44}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	5	0.5
X_{45}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	5	0.5
X_{46}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	5	0.5
X_{47}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	5	0.5
X_{48}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	5	0.5

Table 10 Role matrix for best Case (a) for **iv**—initial values

iv - initial values		1
X_1	type_mom	0
X_2	artificiality_birth	0
X_3	epidural_used	0
X_4	deliv_baby	0
X_5	baby_born	0
X_6	MPPD	0.13
X_7	PPPD	0
X_8	kid_devel	0
X_9	pre_birth_info	0
X_{10}	com_sup_hcp	0
X_{11}	fat_ask_sup_com	0
X_{12}	fat_rec_sup_com	0
X_{13}	post_info_com_par	0
X_{14}	refer_therapist	0
X_{15}	mental_sup	0
X_{16}	acknowl_fat	0
X_{17}	age	1
X_{18}	riskiness	0
X_{19}	dilation_mom	0.2
X_{20}	premature_birth	1
X_{21}	type_com	0
X_{22}	retention	0
X_{23}	engaged	0
X_{24}	stress	0
X_{25}	birth_dev	0
X_{26}	fear_level	0
X_{27}	desire_sup	0
X_{28}	ask_sup	0
X_{29}	$birth\_dev\_det_{HCP}$	0
X_{30}	$det\_risk\_level_{HCP}$	0
X_{31}	$encourage\_mom_{HCP}$	0
X_{32}	$calm\_dad_{HCP}$	0
X_{33}	$irr\_birth\_weight_{HCP}$	0
X_{34}	det_underw_{HCP}	0
X_{35}	$refer\_mom\_ther_{HCP}$	0
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	0
X_{37}	$baby\_born_{HCP}$	0
X_{38}	$type\_com_{HCP}$	0
X_{39}	$type\_mom_{HCP}$	0
X_{40}	$pre\_birth\_info_{HCP}$	0
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1

Table 11 Role matrix for best Case (a) for **ms**—speed factors

ms - speed factors		1
X_1	type_mom	1
X_2	artificiality_birth	1
X_3	epidural_used	1
X_4	deliv_baby	0.2
X_5	baby_born	0.1
X_6	MPPD	0.2
X_7	PPPD	1
X_8	kid_devel	1
X_9	pre_birth_info	0.1
X_{10}	com_sup_hcp	0.1
X_{11}	fat_ask_sup_com	0.3
X_{12}	fat_rec_sup_com	0.1
X_{13}	post_info_com_par	0.1
X_{14}	refer_therapist	0.3
X_{15}	mental_sup	0.1
X_{16}	acknowl_fat	0.1
X_{17}	age	0
X_{18}	riskiness	0.5
X_{19}	dilation_mom	1
X_{20}	premature_birth	0
X_{21}	type_com	1
X_{22}	retention	1
X_{23}	engaged	1
X_{24}	stress	0.4
X_{25}	birth_dev	1
X_{26}	fear_level	1
X_{27}	desire_sup	1
X_{28}	ask_sup	0.2
X_{29}	$\text{birth\_dev\_det}_{HCP}$	1
X_{30}	$\text{det\_risk\_level}_{HCP}$	1
X_{31}	$\text{encourage\_mom}_{HCP}$	0.1
X_{32}	calm_dad_{HCP}	0.1
X_{33}	$\text{irr\_birth\_weight}_{HCP}$	1
X_{34}	det_underw_{HCP}	1
X_{35}	$\text{refer\_mom\_ther}_{HCP}$	0.3
X_{36}	$\text{teach\_dad\_sup\_mom}_{HCP}$	0.1
X_{37}	baby_born_{HCP}	1
X_{38}	type_com_{HCP}	1
X_{39}	type_mom_{HCP}	1
X_{40}	$\text{pre\_birth\_info}_{HCP}$	1
X_{41}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	0
X_{42}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	0
X_{43}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	0
X_{44}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	0
X_{45}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	0
X_{46}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	0
X_{47}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	0
X_{48}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	0

Table 12 Role matrix for worst Case (a) for **mb**—base connectivity

	mb - base connectivity	1	2	3	4	5	6	7	8
X_1	type_mom	X_1							
X_2	artificiality_birth	X_2	X_{18}						
X_3	epidural_used	X_3							
X_4	deliv_baby	X_4	X_{19}						
X_5	baby_born	X_4							
X_6	MPPD	X_1	X_2	X_3	X_5	X_{15}			
X_7	PPPD	X_6	X_{10}	X_{12}	X_{15}	X_{23}	X_{24}		
X_8	imp_kid_devel	X_7							
X_9	pre_birth_info	X_9	X_{40}						
X_{10}	com_sup_hcp	X_4	X_9	X_{11}	X_{24}	X_{30}	X_{32}	X_{34}	X_{36}
X_{11}	fat_ask_sup_com	X_{23}	X_{28}						
X_{12}	fat_rec_sup_com	X_{10}	X_{22}	X_{24}					
X_{13}	post_info_com_par	X_5	X_{20}	X_{31}	X_{32}	X_{36}			
X_{14}	refer_therapist	X_{13}	X_{35}						
X_{15}	mental_sup	X_{14}	X_{21}	X_{31}	X_{32}	X_{35}	X_{36}		
X_{16}	acknowl_fat	X_9	X_{32}	X_{36}					
X_{17}	age	X_{17}							
X_{18}	riskiness	X_5	X_{17}						
X_{19}	dilation_mom	X_{19}							
X_{20}	premature_birth	X_{20}							
X_{21}	type_com	X_{21}	X_{38}						
X_{22}	retention	X_{23}	X_{24}						
X_{23}	engaged	X_{16}							
X_{24}	stress	X_{26}							
X_{25}	birth_dev	X_4	X_{18}						
X_{26}	fear_level	X_{23}	X_{24}	X_{25}					
X_{27}	desire_sup	X_{26}							
X_{28}	ask_sup	X_{27}							
X_{29}	birth_dev_det$_{HCP}$	X_4	X_{18}						
X_{30}	det_risk_level$_{HCP}$	X_{29}							
X_{31}	encourage_mom$_{HCP}$	X_{30}							
X_{32}	calm_dad$_{HCP}$	X_{11}	X_{30}						
X_{33}	irr_birth_weight$_{HCP}$	X_5	X_{20}						
X_{34}	det_underw$_{HCP}$	X_{33}							
X_{35}	refer_mom_ther$_{HCP}$	X_{34}							
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{34}							
X_{37}	baby_born$_{HCP}$	X_5							
X_{38}	type_com$_{HCP}$	X_{37}							
X_{39}	type_mom$_{HCP}$	X_1							
X_{40}	pre_birth_info$_{HCP}$	X_{39}							
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	X_{41}							
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	X_{42}							
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	X_{43}							
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	X_{44}							
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	X_{45}							
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	X_{46}							
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	X_{47}							
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	X_{48}							

Appendix B: Simulation Results in the Software Designed for the Virtual Coach

As the coach is implemented by the Python environment, the Matlab-generated simulation results have been reproduced; see examples below. They are exactly similar to the simulations by the Matlab software, which provides additional verification.

Table 13 Role matrix for worst Case (a) for **mcw**—connection weights

mcw - connection weights		1	2	3	4	5	6	7	8
X_1	type_mom	1							
X_2	artificiality_birth	1	-1						
X_3	epidural_used	1							
X_4	deliv_baby	1	1						
X_5	baby_born	1							
X_6	MPPD	0.25	0.25	0.25	0.25	-1			
X_7	PPPD	1	-0.5	-0.5	-0.5	-0.5	1		
X_8	kid_devel	1							
X_9	pre_birth_info	1	1						
X_{10}	com_sup_hcp	1	1	1	-1	1	1	1	1
X_{11}	fat_ask_sup_com	1	1						
X_{12}	fat_rec_sup_com	1	1	-1					
X_{13}	post_info_com_par	1	1	1	1	1			
X_{14}	refer_therapist	1	1						
X_{15}	mental_sup	1	1	1	1	1	1		
X_{16}	acknowl_fat	1	1	1					
X_{17}	age	1							
X_{18}	riskiness	-1	1						
X_{19}	dilation_mom	1							
X_{20}	premature_birth	1							
X_{21}	type_com	1	1						
X_{22}	retention	2	-1						
X_{23}	engaged	1							
X_{24}	stress	1							
X_{25}	birth_dev	1	1						
X_{26}	fear_level	-1	1	1					
X_{27}	desire_sup	1							
X_{28}	ask_sup	1							
X_{29}	birth_dev_det$_{HCP}$	1	1						
X_{30}	det_risk_level$_{HCP}$	X_{41}							
X_{31}	encourage_mom$_{HCP}$	X_{42}							
X_{32}	calm_dad$_{HCP}$	1	X_{43}						
X_{33}	irr_birth_weight$_{HCP}$	1	2						
X_{34}	det_underw$_{HCP}$	X_{44}							
X_{35}	refer_mom_ther$_{HCP}$	X_{45}							
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{46}							
X_{37}	baby_born$_{HCP}$	1							
X_{38}	type_com$_{HCP}$	X_{47}							
X_{39}	type_mom$_{HCP}$	1							
X_{40}	pre_birth_info$_{HCP}$	X_{48}							
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1							
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1							
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1							
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1							
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1							
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1							
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1							
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1							

Table 14 Role matrix for worst Case (a) for **mcfw**—combination function weights

mcfw - combination function weights		1
		Alogistic
X_1	type_mom	1
X_2	artificiality_birth	1
X_3	epidural_used	1
X_4	deliv_baby	1
X_5	baby_born	1
X_6	MPPD	1
X_7	PPPD	1
X_8	kid_devel	1
X_9	pre_birth_info	1
X_{10}	com_sup_hcp	1
X_{11}	fat_ask_sup_com	1
X_{12}	fat_rec_sup_com	1
X_{13}	post_info_com_par	1
X_{14}	refer_therapist	1
X_{15}	mental_sup	1
X_{16}	acknowl_fat	1
X_{17}	age	1
X_{18}	riskiness	1
X_{19}	dilation_mom	1
X_{20}	premature_birth	1
X_{21}	type_com	1
X_{22}	retention	1
X_{23}	engaged	1
X_{24}	stress	1
X_{25}	birth_dev	1
X_{26}	fear_level	1
X_{27}	desire_sup	1
X_{28}	ask_sup	1
X_{29}	$birth\_dev\_det_{HCP}$	1
X_{30}	$det\_risk\_level_{HCP}$	1
X_{31}	$encourage\_mom_{HCP}$	1
X_{32}	$calm\_dad_{HCP}$	1
X_{33}	$irr\_birth\_weight_{HCP}$	1
X_{34}	det_underw_{HCP}	1
X_{35}	$refer\_mom\_ther_{HCP}$	1
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	1
X_{37}	$baby\_born_{HCP}$	1
X_{38}	$type\_com_{HCP}$	1
X_{39}	$type\_mom_{HCP}$	1
X_{40}	$pre\_birth\_info_{HCP}$	1
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1

Table 15 Role matrix for worst Case (a) for **mcfp**—combination function parameters

mcfp - combination function parameters		1 Alogistic	
		Steepness	Threshold
X_1	type_mom	50	0.5
X_2	artificiality_birth	50	0.5
X_3	epidural_used	50	0.5
X_4	deliv_baby	5	0.5
X_5	baby_born	50	0.5
X_6	MPPD	5	0.3
X_7	PPPD	5	0.5
X_8	kid_devel	5	0.5
X_9	pre_birth_info	50	0.5
X_{10}	com_sup_hcp	0.5	6
X_{11}	fat_ask_sup_com	5	1
X_{12}	fat_rec_sup_com	5	0.5
X_{13}	post_info_com_par	5	4
X_{14}	refer_therapist	5	1
X_{15}	mental_sup	5	5
X_{16}	acknowl_fat	5	0.8
X_{17}	age	5	0.5
X_{18}	riskiness	50	0.5
X_{19}	dilation_mom	2.8	0
X_{20}	premature_birth	5	0.5
X_{21}	type_com	5	0.1
X_{22}	retention	5	0.3
X_{23}	engaged	5	0.5
X_{24}	stress	5	0.5
X_{25}	birth_dev	50	1
X_{26}	fear_level	5	1
X_{27}	desire_sup	5	0.3
X_{28}	ask_sup	5	0.2
X_{29}	$\text{birth\_dev\_det}_{HCP}$	5	1
X_{30}	$\text{det\_risk\_level}_{HCP}$	5	0.5
X_{31}	$\text{encourage\_mom}_{HCP}$	5	0.5
X_{32}	calm_dad_{HCP}	50	0.7
X_{33}	$\text{irr\_birth\_weight}_{HCP}$	5	1
X_{34}	det_underw_{HCP}	5	0.5
X_{35}	$\text{refer\_mom\_ther}_{HCP}$	50	0.5
X_{36}	$\text{teach\_dad\_sup\_mom}_{HCP}$	50	0.7
X_{37}	baby_born_{HCP}	5	0.5
X_{38}	type_com_{HCP}	50	0.5
X_{39}	type_mom_{HCP}	5	0.5
X_{40}	$\text{pre\_birth\_info}_{HCP}$	50	0.5
X_{41}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	5	0.5
X_{42}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	5	0.5
X_{43}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	5	0.5
X_{44}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	5	0.5
X_{45}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	5	0.5
X_{46}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	5	0.5
X_{47}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	5	0.5
X_{48}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	5	0.5

Table 16 Role matrix for worst Case (a) for **iv**—initial values

iv - initial values		1
X_1	type_mom	0
X_2	artificiality_birth	0
X_3	epidural_used	0
X_4	deliv_baby	0
X_5	baby_born	0
X_6	MPPD	0.13
X_7	PPPD	0
X_8	kid_devel	0
X_9	pre_birth_info	0
X_{10}	com_sup_hcp	0
X_{11}	fat_ask_sup_com	0
X_{12}	fat_rec_sup_com	0
X_{13}	post_info_com_par	0
X_{14}	refer_therapist	0
X_{15}	mental_sup	0
X_{16}	acknowl_fat	0
X_{17}	age	1
X_{18}	riskiness	0
X_{19}	dilation_mom	0.2
X_{20}	premature_birth	1
X_{21}	type_com	0
X_{22}	retention	0
X_{23}	engaged	0
X_{24}	stress	0
X_{25}	birth_dev	0
X_{26}	fear_level	0
X_{27}	desire_sup	0
X_{28}	ask_sup	0
X_{29}	$birth\_dev\_det_{HCP}$	0
X_{30}	$det\_risk\_level_{HCP}$	0
X_{31}	$encourage\_mom_{HCP}$	0
X_{32}	$calm\_dad_{HCP}$	0
X_{33}	$irr\_birth\_weight_{HCP}$	0
X_{34}	det_underw_{HCP}	0
X_{35}	$refer\_mom\_ther_{HCP}$	0
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	0
X_{37}	$baby\_born_{HCP}$	0
X_{38}	$type\_com_{HCP}$	0
X_{39}	$type\_mom_{HCP}$	0
X_{40}	$pre\_birth\_info_{HCP}$	0
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	0
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	0
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	0
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	0
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	0
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	0
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	0
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	0

Table 17 Role matrix for worst Case (a) for **ms**—speed factors

ms - speed factors		1
X_1	type_mom	1
X_2	artificiality_birth	1
X_3	epidural_used	1
X_4	deliv_baby	0.2
X_5	baby_born	0.1
X_6	MPPD	0.2
X_7	PPPD	1
X_8	kid_devel	1
X_9	pre_birth_info	0.1
X_{10}	com_sup_hcp	0.1
X_{11}	fat_ask_sup_com	0.3
X_{12}	fat_rec_sup_com	0.1
X_{13}	post_info_com_par	0.1
X_{14}	refer_therapist	0.3
X_{15}	mental_sup	0.1
X_{16}	acknowl_fat	0.1
X_{17}	age	0
X_{18}	riskiness	0.5
X_{19}	dilation_mom	1
X_{20}	premature_birth	0
X_{21}	type_com	1
X_{22}	retention	1
X_{23}	engaged	1
X_{24}	stress	0.4
X_{25}	birth_dev	1
X_{26}	fear_level	1
X_{27}	desire_sup	1
X_{28}	ask_sup	0.2
X_{29}	$birth\_dev\_det_{HCP}$	1
X_{30}	$det\_risk\_level_{HCP}$	1
X_{31}	$encourage\_mom_{HCP}$	0.1
X_{32}	$calm\_dad_{HCP}$	0.1
X_{33}	$irr\_birth\_weight_{HCP}$	1
X_{34}	det_underw_{HCP}	1
X_{35}	$refer\_mom\_ther_{HCP}$	0.3
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	0.1
X_{37}	$baby\_born_{HCP}$	1
X_{38}	$type\_com_{HCP}$	1
X_{39}	$type\_mom_{HCP}$	1
X_{40}	$pre\_birth\_info_{HCP}$	1
X_{41}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	0
X_{42}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	0
X_{43}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	0
X_{44}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	0
X_{45}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	0
X_{46}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	0
X_{47}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	0
X_{48}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	0

Table 18 Role matrix for Case (b) for **mb**—base connectivity

	mb - base connectivity	1	2	3	4	5	6	7	8	9	10	11	12
X_1	type_mom	X_1											
X_2	artificiality_birth	X_2	X_{18}										
X_3	epidural_used	X_3											
X_4	deliv_baby	X_4	X_{19}										
X_5	baby_born	X_4											
X_6	MPPD	X_1	X_2	X_3	X_5	X_{15}							
X_7	PPPD	X_6	X_{10}	X_{12}	X_{15}	X_{23}	X_{24}						
X_8	imp_kid_devel	X_7											
X_9	pre_birth_info	X_9	X_{40}	X_{52}									
X_{10}	com_sup_hcp	X_4	X_9	X_{11}	X_{24}	X_{30}	X_{32}	X_{34}	X_{36}	X_{42}	X_{44}	X_{46}	X_{48}
X_{11}	fat_ask_sup_com	X_{23}	X_{28}										
X_{12}	fat_rec_sup_com	X_{10}	X_{22}	X_{24}									
X_{13}	post_info_com_par	X_5	X_{20}	X_{31}	X_{32}	X_{36}	X_{43}	X_{44}	X_{48}				
X_{14}	refer_therapist	X_{13}	X_{35}	X_{47}									
X_{15}	mental_sup	X_{14}	X_{21}	X_{31}	X_{32}	X_{35}	X_{36}	X_{43}	X_{44}	X_{47}	X_{48}		
X_{16}	acknowl_fat	X_9	X_{32}	X_{36}	X_{44}	X_{48}							
X_{17}	age	X_{17}											
X_{18}	riskiness	X_5	X_{17}										
X_{19}	dilation_mom	X_{19}											
X_{20}	premature_birth	X_{20}											
X_{21}	type_com	X_{21}	X_{38}	X_{50}									
X_{22}	retention	X_{23}	X_{24}										
X_{23}	engaged	X_{16}											
X_{24}	stress	X_{35}											
X_{25}	birth_dev	X_4	X_{18}										
X_{26}	fear_level	X_{23}	X_{24}	X_{25}									
X_{27}	desire_sup	X_{26}											
X_{28}	ask_sup	X_{27}											
X_{29}	birth_dev_det$_{HCP}$	X_4	X_{18}										
X_{30}	det_risk_level$_{HCP}$	X_{29}											
X_{31}	encourage_mom$_{HCP}$	X_{30}											
X_{32}	calm_dad$_{HCP}$	X_{11}	X_{30}										
X_{33}	irr_birth_weight$_{HCP}$	X_5	X_{20}										
X_{34}	det_underw$_{HCP}$	X_{33}											
X_{35}	refer_mom_ther$_{HCP}$	X_{34}											
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{34}											
X_{37}	baby_born$_{HCP}$	X_5											
X_{38}	type_com$_{HCP}$	X_{37}											
X_{39}	type_mom$_{HCP}$	X_1											
X_{40}	pre_birth_info$_{HCP}$	X_{39}											
X_{41}	birth_dev_det$_{AIC}$	X_4	X_{18}										
X_{42}	det_risk_level$_{AIC}$	X_{41}											
X_{43}	encourage_mom$_{AIC}$	X_{42}											
X_{44}	calm_dad$_{AIC}$	X_{11}	X_{42}										
X_{45}	irr_birth_weight$_{AIC}$	X_5	X_{20}										
X_{46}	det_underw$_{AIC}$	X_{45}											
X_{47}	refer_mom_ther$_{AIC}$	X_{46}											
X_{48}	teach_dad_sup_mom$_{AIC}$	X_{46}											
X_{49}	baby_born$_{AIC}$	X_5											
X_{50}	type_com$_{AIC}$	X_{49}											
X_{51}	type_mom$_{AIC}$	X_1											
X_{52}	pre_birth_info$_{AIC}$	X_{51}											
X_{53}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	X_{53}											
X_{54}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	X_{54}											
X_{55}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	X_{55}											
X_{56}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	X_{56}											
X_{57}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	X_{57}											
X_{58}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	X_{58}											
X_{59}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	X_{59}											
X_{60}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	X_{60}											
X_{61}	$\mathbf{W}_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	X_{61}											
X_{62}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	X_{62}											
X_{63}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	X_{63}											
X_{64}	$\mathbf{W}_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	X_{64}											
X_{65}	$\mathbf{W}_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	X_{65}											
X_{66}	$\mathbf{W}_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	X_{66}											
X_{67}	$\mathbf{W}_{\text{baby\_born\_AIC, type\_com\_AIC}}$	X_{67}											
X_{68}	$\mathbf{W}_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	X_{68}											
X_{69}	$\mathbf{H}_{\text{encourage\_mom\_AIC}}$	X_{75}											
X_{70}	$\mathbf{H}_{\text{calm\_dad\_AIC}}$	X_{75}											
X_{71}	$\mathbf{H}_{\text{refer\_mom\_ther\_AIC}}$	X_{75}											
X_{72}	$\mathbf{H}_{\text{teach\_dad\_sup\_mom\_AIC}}$	X_{75}											
X_{73}	$\mathbf{H}_{\text{type\_com\_AIC}}$	X_{75}											
X_{74}	$\mathbf{H}_{\text{pre\_birth\_info\_AIC}}$	X_{75}											
X_{75}	con_act_AIC	X_{75}											

Table 19 Role matrix for Case (b) for **mcw**—connection weights

	mcw - connection weights	1	2	3	4	5	6	7	8	9	10	11	12
X_1	type_mom	1											
X_2	artificiality_birth	1	-1										
X_3	epidural_used	1											
X_4	deliv_baby	1	1										
X_5	baby_born	1											
X_6	MPPD	0.25	0.25	0.25	0.25	-1							
X_7	PPPD	1	-0.5	-0.5	-0.5	-0.5	1						
X_8	kid_devel	1											
X_9	pre_birth_info	1	1	1									
X_{10}	com_sup_hcp	1	1	1	-1	1	1	1	1	1	1	1	1
X_{11}	fat_ask_sup_com	1	1										
X_{12}	fat_rec_sup_com	1	1	-1									
X_{13}	post_info_com_par	1	1	1	1	1	1	1	1				
X_{14}	refer_therapist	1	1	1									
X_{15}	mental_sup	1	1	1	1	1	1	1	1	1	1		
X_{16}	acknowl_fat	1	1	1	1	1							
X_{17}	age	1											
X_{18}	riskiness	-1	1										
X_{19}	dilation_mom	1											
X_{20}	premature_birth	1											
X_{21}	type_com	1	1	1									
X_{22}	retention	2	-1										
X_{23}	engaged	1											
X_{24}	stress	1											
X_{25}	birth_dev	1	1										
X_{26}	fear_level	-1	1	1									
X_{27}	desire_sup	1											
X_{28}	ask_sup	1											
X_{29}	birth_dev_det$_{HCP}$	1	1										
X_{30}	det_risk_level$_{HCP}$	X_{53}											
X_{31}	encourage_mom$_{HCP}$	X_{54}											
X_{32}	calm_dad$_{HCP}$	1	X_{55}										
X_{33}	irr_birth_weight$_{HCP}$	1	2										
X_{34}	det_underw$_{HCP}$	X_{56}											
X_{35}	refer_mom_ther$_{HCP}$	X_{57}											
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{58}											
X_{37}	baby_born$_{HCP}$	1											
X_{38}	type_com$_{HCP}$	X_{59}											
X_{39}	type_mom$_{HCP}$	1											
X_{40}	pre_birth_info$_{HCP}$	X_{60}											
X_{41}	birth_dev_det$_{AIC}$	1	1										
X_{42}	det_risk_level$_{AIC}$	X_{61}											
X_{43}	encourage_mom$_{AIC}$	X_{62}											
X_{44}	calm_dad$_{AIC}$	1	X_{63}										
X_{45}	irr_birth_weight$_{AIC}$	1	2										
X_{46}	det_underw$_{AIC}$	X_{64}											
X_{47}	refer_mom_ther$_{AIC}$	X_{65}											
X_{48}	teach_dad_sup_mom$_{AIC}$	X_{66}											
X_{49}	baby_born$_{AIC}$	1											
X_{50}	type_com$_{AIC}$	X_{67}											
X_{51}	type_mom$_{AIC}$	1											
X_{52}	pre_birth_info$_{AIC}$	X_{68}											
X_{53}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	1											
X_{54}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	1											
X_{55}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	1											
X_{56}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	1											
X_{57}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	1											
X_{58}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	1											
X_{59}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	1											
X_{60}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	1											
X_{61}	$\mathbf{W}_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	1											
X_{62}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	1											
X_{63}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	1											
X_{64}	$\mathbf{W}_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	1											
X_{65}	$\mathbf{W}_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	1											
X_{66}	$\mathbf{W}_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	1											
X_{67}	$\mathbf{W}_{\text{baby\_born\_AIC, type\_com\_AIC}}$	1											
X_{68}	$\mathbf{W}_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	1											
X_{69}	$\mathbf{H}_{\text{encourage\_mom\_AIC}}$	1											
X_{70}	$\mathbf{H}_{\text{calm\_dad\_AIC}}$	1											
X_{71}	$\mathbf{H}_{\text{refer\_mom\_ther\_AIC}}$	1											
X_{72}	$\mathbf{H}_{\text{teach\_dad\_sup\_mom\_AIC}}$	1											
X_{73}	$\mathbf{H}_{\text{type\_com\_AIC}}$	1											
X_{74}	$\mathbf{H}_{\text{pre\_birth\_info\_AIC}}$	1											
X_{75}	con_act_AIC	1											

Table 20 Role matrix for Case (b) for **mcfw**—combination function weights

mcfw - combination function weights		1	2
		Alogistic	Steponce
X_1	type_mom	1	
X_2	artificiality_birth	1	
X_3	epidural_used	1	
X_4	deliv_baby	1	
X_5	baby_born	1	
X_6	MPPD	1	
X_7	PPPD	1	
X_8	kid_devel	1	
X_9	pre_birth_info	1	
X_{10}	com_sup_hcp	1	
X_{11}	fat_ask_sup_com	1	
X_{12}	fat_rec_sup_com	1	
X_{13}	post_info_com_par	1	
X_{14}	refer_therapist	1	
X_{15}	mental_sup	1	
X_{16}	acknowl_fat	1	
X_{17}	age	1	
X_{18}	riskiness	1	
X_{19}	dilation_mom	1	
X_{20}	premature_birth	1	
X_{21}	type_com	1	
X_{22}	retention	1	
X_{23}	engaged	1	
X_{24}	stress	1	
X_{25}	birth_dev	1	
X_{26}	fear_level	1	
X_{27}	desire_sup	1	
X_{28}	ask_sup	1	
X_{29}	$birth\_dev\_det_{HCP}$	1	
X_{30}	$det\_risk\_level_{HCP}$	1	
X_{31}	$encourage\_mom_{HCP}$	1	
X_{32}	$calm\_dad_{HCP}$	1	
X_{33}	$irr\_birth\_weight_{HCP}$	1	
X_{34}	det_underw_{HCP}	1	
X_{35}	$refer\_mom\_ther_{HCP}$	1	
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	1	
X_{37}	$baby\_born_{HCP}$	1	
X_{38}	$type\_com_{HCP}$	1	
X_{39}	$type\_mom_{HCP}$	1	
X_{40}	$pre\_birth\_info_{HCP}$	1	
X_{41}	$birth\_dev\_det_{AIC}$	1	
X_{42}	$det\_risk\_level_{AIC}$	1	
X_{43}	$encourage\_mom_{AIC}$	1	
X_{44}	$calm\_dad_{AIC}$	1	
X_{45}	$irr\_birth\_weight_{AIC}$	1	
X_{46}	det_underw_{AIC}	1	
X_{47}	$refer\_mom\_ther_{AIC}$	1	
X_{48}	$teach\_dad\_sup\_mom_{AIC}$	1	
X_{49}	$baby\_born_{AIC}$	1	
X_{50}	$type\_com_{AIC}$	1	
X_{51}	$type\_mom_{AIC}$	1	
X_{52}	$pre\_birth\_info_{AIC}$	1	
X_{53}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1	
X_{54}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1	
X_{55}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1	
X_{56}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1	
X_{57}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1	
X_{58}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1	
X_{59}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1	
X_{60}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1	
X_{61}	$\mathbf{W}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	1	
X_{62}	$\mathbf{W}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	1	
X_{63}	$\mathbf{W}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	1	
X_{64}	$\mathbf{W}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	1	
X_{65}	$\mathbf{W}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	1	
X_{66}	$\mathbf{W}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	1	
X_{67}	$\mathbf{W}_{baby\_born\_AIC,\ type\_com\_AIC}$	1	
X_{68}	$\mathbf{W}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	1	
X_{69}	$\mathbf{H}_{encourage\_mom\_AIC}$	1	
X_{70}	$\mathbf{H}_{calm\_dad\_AIC}$	1	
X_{71}	$\mathbf{H}_{refer\_mom\_ther\_AIC}$	1	
X_{72}	$\mathbf{H}_{teach\_dad\_sup\_mom\_AIC}$	1	
X_{73}	$\mathbf{H}_{type\_com\_AIC}$	1	
X_{74}	$\mathbf{H}_{pre\_birth\_info\_AIC}$	1	
X_{75}	con_act_AIC		1

Table 21 Role matrix for Case (b) for **mcfp**—combination function parameters

mcfp - combination function parameters		1 Alogistic		2 Steponce	
		Steepness	Threshold	Start Time	End Time
X_1	type_mom	50	0.5		
X_2	artificiality_birth	50	0.5		
X_3	epidural_used	50	0.5		
X_4	deliv_baby	5	0.5		
X_5	baby_born	50	0.5		
X_6	MPPD	5	0.3		
X_7	PPPD	5	0.5		
X_8	kid_devel	5	0.5		
X_9	pre_birth_info	50	0.5		
X_{10}	com_sup_hcp	0.5	6		
X_{11}	fat_ask_sup_com	5	1		
X_{12}	fat_rec_sup_com	5	0.5		
X_{13}	post_info_com_par	5	4		
X_{14}	refer_therapist	5	1		
X_{15}	mental_sup	5	5		
X_{16}	acknowl_fat	5	0.8		
X_{17}	age	5	0.5		
X_{18}	riskiness	50	0.5		
X_{19}	dilation_mom	2.8	0		
X_{20}	premature_birth	5	0.5		
X_{21}	type_com	5	0.1		
X_{22}	retention	5	0.3		
X_{23}	engaged	5	0.5		
X_{24}	stress	5	0.5		
X_{25}	birth_dev	50	1		
X_{26}	fear_level	5	1		
X_{27}	desire_sup	5	0.3		
X_{28}	ask_sup	5	0.2		
X_{29}	birth_dev_det$_{HCP}$	5	1		
X_{30}	det_risk_level$_{HCP}$	5	0.5		
X_{31}	encourage_mom$_{HCP}$	5	0.5		
X_{32}	calm_dad$_{HCP}$	50	0.7		
X_{33}	irr_birth_weight$_{HCP}$	5	1		
X_{34}	det_underw$_{HCP}$	5	0.5		
X_{35}	refer_mom_ther$_{HCP}$	50	0.5		
X_{36}	teach_dad_sup_mom$_{HCP}$	50	0.7		
X_{37}	baby_born$_{HCP}$	5	0.5		
X_{38}	type_com$_{HCP}$	50	0.5		
X_{39}	type_mom$_{HCP}$	5	0.5		
X_{40}	pre_birth_info$_{HCP}$	50	0.5		
X_{41}	birth_dev_det$_{AIC}$	5	1		
X_{42}	det_risk_level$_{AIC}$	5	0.5		
X_{43}	encourage_mom$_{AIC}$	5	0.5		
X_{44}	calm_dad$_{AIC}$	50	0.7		
X_{45}	irr_birth_weight$_{AIC}$	5	1		
X_{46}	det_underw$_{AIC}$	5	0.5		
X_{47}	refer_mom_ther$_{AIC}$	50	0.5		
X_{48}	teach_dad_sup_mom$_{AIC}$	50	0.7		
X_{49}	baby_born$_{AIC}$	5	0.5		
X_{50}	type_com$_{AIC}$	50	0.5		
X_{51}	type_mom$_{AIC}$	5	0.5		
X_{52}	pre_birth_info$_{AIC}$	50	0.5		
X_{53}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	5	0.5		
X_{54}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	5	0.5		
X_{55}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	5	0.5		
X_{56}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	5	0.5		
X_{57}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	5	0.5		
X_{58}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	5	0.5		
X_{59}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	5	0.5		
X_{60}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	5	0.5		
X_{61}	$\mathbf{W}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	5	0.5		
X_{62}	$\mathbf{W}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	5	0.5		
X_{63}	$\mathbf{W}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	5	0.5		
X_{64}	$\mathbf{W}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	5	0.5		
X_{65}	$\mathbf{W}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	5	0.5		
X_{66}	$\mathbf{W}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	5	0.5		
X_{67}	$\mathbf{W}_{baby\_born\_AIC,\ type\_com\_AIC}$	5	0.5		
X_{68}	$\mathbf{W}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	5	0.5		
X_{69}	$\mathbf{H}_{encourage\_mom\_AIC}$	5	0.5		
X_{70}	$\mathbf{H}_{calm\_dad\_AIC}$	5	0.5		
X_{71}	$\mathbf{H}_{refer\_mom\_ther\_AIC}$	5	0.5		
X_{72}	$\mathbf{H}_{teach\_dad\_sup\_mom\_AIC}$	5	0.5		
X_{73}	$\mathbf{H}_{type\_com\_AIC}$	5	0.5		
X_{74}	$\mathbf{H}_{pre\_birth\_info\_AIC}$	5	0.5		
X_{75}	con_act_AIC			20	60

Table 22 Role matrix for Case (b) for **ms**—speed factors

ms - speed factors		1
X_1	type_mom	1
X_2	artificiality_birth	1
X_3	epidural_used	1
X_4	deliv_baby	0.2
X_5	baby_born	0.1
X_6	MPPD	0.2
X_7	PPPD	1
X_8	kid_devel	1
X_9	pre_birth_info	0.1
X_{10}	com_sup_hcp	0.1
X_{11}	fat_ask_sup_com	0.3
X_{12}	fat_rec_sup_com	0.1
X_{13}	post_info_com_par	0.1
X_{14}	refer_therapist	0.3
X_{15}	mental_sup	0.1
X_{16}	acknowl_fat	0.1
X_{17}	age	0
X_{18}	riskiness	0.5
X_{19}	dilation_mom	1
X_{20}	premature_birth	0
X_{21}	type_com	1
X_{22}	retention	1
X_{23}	engaged	1
X_{24}	stress	0.4
X_{25}	birth_dev	1
X_{26}	fear_level	1
X_{27}	desire_sup	1
X_{28}	ask_sup	0.2
X_{29}	$\text{birth\_dev\_det}_{\text{HCP}}$	1
X_{30}	$\text{det\_risk\_level}_{\text{HCP}}$	1
X_{31}	$\text{encourage\_mom}_{\text{HCP}}$	0.1
X_{32}	$\text{calm\_dad}_{\text{HCP}}$	0.1
X_{33}	$\text{irr\_birth\_weight}_{\text{HCP}}$	1
X_{34}	$\text{det\_underw}_{\text{HCP}}$	1
X_{35}	$\text{refer\_mom\_ther}_{\text{HCP}}$	0.3
X_{36}	$\text{teach\_dad\_sup\_mom}_{\text{HCP}}$	0.1
X_{37}	$\text{baby\_born}_{\text{HCP}}$	1
X_{38}	$\text{type\_com}_{\text{HCP}}$	1
X_{39}	$\text{type\_mom}_{\text{HCP}}$	1
X_{40}	$\text{pre\_birth\_info}_{\text{HCP}}$	1
X_{41}	$\text{birth\_dev\_det}_{\text{AIC}}$	1
X_{42}	$\text{det\_risk\_level}_{\text{AIC}}$	1
X_{43}	$\text{encourage\_mom}_{\text{AIC}}$	X_{69}
X_{44}	$\text{calm\_dad}_{\text{AIC}}$	X_{70}
X_{45}	$\text{irr\_birth\_weight}_{\text{AIC}}$	1
X_{46}	$\text{det\_underw}_{\text{AIC}}$	1
X_{47}	$\text{refer\_mom\_ther}_{\text{AIC}}$	X_{71}
X_{48}	$\text{teach\_dad\_sup\_mom}_{\text{AIC}}$	X_{72}
X_{49}	$\text{baby\_born}_{\text{AIC}}$	1
X_{50}	$\text{type\_com}_{\text{AIC}}$	X_{73}
X_{51}	$\text{type\_mom}_{\text{AIC}}$	1
X_{52}	$\text{pre\_birth\_info}_{\text{AIC}}$	X_{74}
X_{53}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	0
X_{54}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	0
X_{55}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	0
X_{56}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	0
X_{57}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	0
X_{58}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	0
X_{59}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	0
X_{60}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	0
X_{61}	$\mathbf{W}_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	0
X_{62}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	0
X_{63}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	0
X_{64}	$\mathbf{W}_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	0
X_{65}	$\mathbf{W}_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	0
X_{66}	$\mathbf{W}_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	0
X_{67}	$\mathbf{W}_{\text{baby\_born\_AIC, type\_com\_AIC}}$	0
X_{68}	$\mathbf{W}_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	0
X_{69}	$\mathbf{H}_{\text{encourage\_mom\_AIC}}$	0.1
X_{70}	$\mathbf{H}_{\text{calm\_dad\_AIC}}$	0.1
X_{71}	$\mathbf{H}_{\text{refer\_mom\_ther\_AIC}}$	0.1
X_{72}	$\mathbf{H}_{\text{teach\_dad\_sup\_mom\_AIC}}$	0.1
X_{73}	$\mathbf{H}_{\text{type\_com\_AIC}}$	0.1
X_{74}	$\mathbf{H}_{\text{pre\_birth\_info\_AIC}}$	0.1
X_{75}	con_act_AIC	1

Table 23 Role matrix for Case (b) for **iv**—initial values

	iv - initial values	1
X_1	type_mom	0
X_2	artificiality_birth	0
X_3	epidural_used	0
X_4	deliv_baby	0
X_5	baby_born	0
X_6	MPPD	0.13
X_7	PPPD	0
X_8	kid_devel	0
X_9	pre_birth_info	0
X_{10}	com_sup_hcp	0
X_{11}	fat_ask_sup_com	0
X_{12}	fat_rec_sup_com	0
X_{13}	post_info_com_par	0
X_{14}	refer_therapist	0
X_{15}	mental_sup	0
X_{16}	acknowl_fat	0
X_{17}	age	1
X_{18}	riskiness	0
X_{19}	dilation_mom	0.2
X_{20}	premature_birth	1
X_{21}	type_com	0
X_{22}	retention	0
X_{23}	engaged	0
X_{24}	stress	0
X_{25}	birth_dev	0
X_{26}	fear_level	0
X_{27}	desire_sup	0
X_{28}	ask_sup	0
X_{29}	$birth\_dev\_det_{HCP}$	0
X_{30}	$det\_risk\_level_{HCP}$	0
X_{31}	$encourage\_mom_{HCP}$	0
X_{32}	$calm\_dad_{HCP}$	0
X_{33}	$irr\_birth\_weight_{HCP}$	0
X_{34}	det_underw_{HCP}	0
X_{35}	$refer\_mom\_ther_{HCP}$	0
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	0
X_{37}	$baby\_born_{HCP}$	0
X_{38}	$type\_com_{HCP}$	0
X_{39}	$type\_mom_{HCP}$	0
X_{40}	$pre\_birth\_info_{HCP}$	0
X_{41}	$birth\_dev\_det_{AIC}$	0
X_{42}	$det\_risk\_level_{AIC}$	0
X_{43}	$encourage\_mom_{AIC}$	0
X_{44}	$calm\_dad_{AIC}$	0
X_{45}	$irr\_birth\_weight_{AIC}$	0
X_{46}	det_underw_{AIC}	0
X_{47}	$refer\_mom\_ther_{AIC}$	0
X_{48}	$teach\_dad\_sup\_mom_{AIC}$	0
X_{49}	$baby\_born_{AIC}$	0
X_{50}	$type\_com_{AIC}$	0
X_{51}	$type\_mom_{AIC}$	0
X_{52}	$pre\_birth\_info_{AIC}$	0
X_{53}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	0
X_{54}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	0
X_{55}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	0
X_{56}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	0
X_{57}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	0
X_{58}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	0
X_{59}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	0
X_{60}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	0
X_{61}	$\mathbf{W}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	1
X_{62}	$\mathbf{W}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	1
X_{63}	$\mathbf{W}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	1
X_{64}	$\mathbf{W}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	1
X_{65}	$\mathbf{W}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	1
X_{66}	$\mathbf{W}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	1
X_{67}	$\mathbf{W}_{baby\_born\_AIC,\ type\_com\_AIC}$	1
X_{68}	$\mathbf{W}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	1
X_{69}	$\mathbf{H}_{encourage\_mom\_AIC}$	0
X_{70}	$\mathbf{H}_{calm\_dad\_AIC}$	0
X_{71}	$\mathbf{H}_{refer\_mom\_ther\_AIC}$	0
X_{72}	$\mathbf{H}_{teach\_dad\_sup\_mom\_AIC}$	0
X_{73}	$\mathbf{H}_{type\_com\_AIC}$	0
X_{74}	$\mathbf{H}_{pre\_birth\_info\_AIC}$	0
X_{75}	con_act_AIC	1

Table 24 Role matrix for Case (c) for **mb**—base connectivity

	mb - base connectivity	1	2	3	4	5	6	7	8	9	10	11	12
X_1	type_mom	X_1											
X_2	artificiality_birth	X_2	X_{18}										
X_3	epidural_used	X_3											
X_4	deliv_baby	X_4	X_{19}										
X_5	baby_born	X_4											
X_6	MPPD	X_1	X_2	X_3	X_5	X_{15}							
X_7	PPPD	X_6	X_{10}	X_{12}	X_{15}	X_{23}	X_{24}						
X_8	imp_kid_devel	X_7											
X_9	pre_birth_info	X_8	X_{40}	X_{42}									
X_{10}	com_sup_hcp	X_4	X_9	X_{11}	X_{24}	X_{30}	X_{32}	X_{34}	X_{36}	X_{42}	X_{44}	X_{46}	X_{48}
X_{11}	fat_ask_sup_com	X_{33}	X_{38}										
X_{12}	fat_rec_sup_com	X_{10}	X_{22}	X_{24}									
X_{13}	post_info_com_par	X_5	X_{20}	X_{31}	X_{32}	X_{36}	X_{43}	X_{44}	X_{48}				
X_{14}	refer_therapist	X_{13}	X_{35}	X_{47}									
X_{15}	mental_sup	X_{14}	X_{21}	X_{31}	X_{32}	X_{35}	X_{36}	X_{43}	X_{44}	X_{47}	X_{48}		
X_{16}	acknowl_fat	X_6	X_{32}	X_{36}	X_{44}	X_{48}							
X_{17}	age	X_{17}											
X_{18}	riskiness	X_5	X_{17}										
X_{19}	dilation_mom	X_{19}											
X_{20}	premature_birth	X_{20}											
X_{21}	type_com	X_{21}	X_{38}	X_{50}									
X_{22}	retention	X_{23}	X_{24}										
X_{23}	engaged	X_{16}											
X_{24}	stress	X_{16}											
X_{25}	birth_dev	X_4	X_{18}										
X_{26}	fear_level	X_{23}	X_{24}	X_{25}									
X_{27}	desire_sup	X_{26}											
X_{28}	ask_sup	X_{27}											
X_{29}	birth_dev_det$_{HCP}$	X_4	X_{18}										
X_{30}	det_risk_level$_{HCP}$	X_{29}											
X_{31}	encourage_mom$_{HCP}$	X_{30}											
X_{32}	calm_dad$_{HCP}$	X_{11}	X_{30}										
X_{33}	irr_birth_weight$_{HCP}$	X_5	X_{20}										
X_{34}	det_underw$_{HCP}$	X_{33}											
X_{35}	refer_mom_ther$_{HCP}$	X_{34}											
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{34}											
X_{37}	baby_born$_{HCP}$	X_5											
X_{38}	type_com$_{HCP}$	X_{37}											
X_{39}	type_mom$_{HCP}$	X_1											
X_{40}	pre_birth_info$_{HCP}$	X_{39}											
X_{41}	birth_dev_det$_{AIC}$	X_4	X_{18}										
X_{42}	det_risk_level$_{AIC}$	X_{41}											
X_{43}	encourage_mom$_{AIC}$	X_{42}											
X_{44}	calm_dad$_{AIC}$	X_{11}	X_{42}										
X_{45}	irr_birth_weight$_{AIC}$	X_5	X_{20}										
X_{46}	det_underw$_{AIC}$	X_{45}											
X_{47}	refer_mom_ther$_{AIC}$	X_{46}											
X_{48}	teach_dad_sup_mom$_{AIC}$	X_{46}											
X_{49}	baby_born$_{AIC}$	X_5											
X_{50}	type_com$_{AIC}$	X_{49}											
X_{51}	type_mom$_{AIC}$	X_1											
X_{52}	pre_birth_info$_{AIC}$	X_{51}											
X_{53}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	X_{53}											
X_{54}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	X_{54}											
X_{55}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	X_{55}											
X_{56}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	X_{56}											
X_{57}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	X_{57}											
X_{58}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	X_{58}											
X_{59}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	X_{59}											
X_{60}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	X_{60}											
X_{61}	$\mathbf{W}_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	X_{61}											
X_{62}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	X_{62}											
X_{63}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	X_{63}											
X_{64}	$\mathbf{W}_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	X_{64}											
X_{65}	$\mathbf{W}_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	X_{65}											
X_{66}	$\mathbf{W}_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	X_{66}											
X_{67}	$\mathbf{W}_{\text{baby\_born\_AIC, type\_com\_AIC}}$	X_{67}											
X_{68}	$\mathbf{W}_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	X_{68}											
X_{69}	$\mathbf{W}_{\text{pre\_birth\_info\_AIC, pre\_birth\_info}}$	X_{83}											
X_{70}	$\mathbf{W}_{\text{calm\_dad\_AIC, acknowl\_fat}}$	X_{85}											
X_{71}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, acknowl\_fat}}$	X_{84}											
X_{72}	$\mathbf{W}_{\text{calm\_dad\_AIC, com\_sup\_hcp}}$	X_{86}											
X_{73}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, com\_sup\_hcp}}$	X_{87}											
X_{74}	$\mathbf{W}_{\text{calm\_dad\_AIC, post\_info\_com\_par}}$	X_{89}											
X_{75}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, post\_info\_com\_par}}$	X_{90}											
X_{76}	$\mathbf{W}_{\text{encourage\_mom\_AIC, post\_info\_com\_par}}$	X_{88}											
X_{77}	$\mathbf{W}_{\text{refer\_mom\_ther\_AIC, refer\_therapist}}$	X_{91}											
X_{78}	$\mathbf{W}_{\text{calm\_dad\_AIC, mental\_sup}}$	X_{94}											
X_{79}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, mental\_sup}}$	X_{95}											
X_{80}	$\mathbf{W}_{\text{encourage\_mom\_AIC, mental\_sup}}$	X_{92}											
X_{81}	$\mathbf{W}_{\text{refer\_mom\_ther\_AIC, mental\_sup}}$	X_{93}											
X_{82}	$\mathbf{W}_{\text{type\_com\_AIC, type\_com}}$	X_{96}											
X_{83}	monitor_pre_birth_info	X_{12}	X_9										
X_{84}	monitor_acknowl_fat$_1$	X_{16}	X_{16}										
X_{85}	monitor_acknowl_fat$_2$	X_{14}	X_{16}										
X_{86}	monitor_com_sup_hcp$_1$	X_{44}	X_{10}										
X_{87}	monitor_com_sup_hcp$_2$	X_{48}	X_{10}										
X_{88}	monitor_post_info_com_par$_1$	X_{43}	X_{13}										
X_{89}	monitor_post_info_com_par$_2$	X_{44}	X_{13}										
X_{90}	monitor_post_info_com_par$_3$	X_{48}	X_{13}										
X_{91}	monitor_refer_therapist	X_{47}	X_{14}										
X_{92}	monitor_mental_sup$_1$	X_{43}	X_{15}										
X_{93}	monitor_mental_sup$_2$	X_{47}	X_{15}										
X_{94}	monitor_mental_sup$_3$	X_{44}	X_{15}										
X_{95}	monitor_mental_sup$_4$	X_{48}	X_{15}										
X_{96}	monitor_type_com	X_{50}	X_{21}										

Table 25 Role matrix for Case (c) for **mcw**—connection weights

	mcw - connection weights	1	2	3	4	5	6	7	8	9	10	11	12
X_1	type_mom	1											
X_2	artificiality_birth	1	-1										
X_3	epidural_used	1											
X_4	deliv_baby	1	1										
X_5	baby_born	1											
X_6	MPPD	0.25	0.25	0.25	0.25	-1							
X_7	PPPD	1	-0.5	-0.5	-0.5	-0.5	1						
X_8	kid_devel	1											
X_9	pre_birth_info	1	1	X_{69}									
X_{10}	com_sup_hcp	1	1	1	-1	1	1	1	1	1	X_{72}	1	X_{73}
X_{11}	fat_ask_sup_com	1	1										
X_{12}	fat_rec_sup_com	1	1	-1									
X_{13}	post_info_com_par	1	1	1	1	1	X_{76}	X_{74}	X_{75}				
X_{14}	refer_therapist	1	1	X_{77}									
X_{15}	mental_sup	1	1	1	1	1	1	X_{80}	X_{78}	X_{81}	X_{79}		
X_{16}	acknowl_fat	1	1	1	X_{70}	X_{71}							
X_{17}	age	1											
X_{18}	riskiness	-1	1										
X_{19}	dilation_mom	1											
X_{20}	premature_birth	1											
X_{21}	type_com	1	1	X_{62}									
X_{22}	retention	2	-1										
X_{23}	engaged	1											
X_{24}	stress	1											
X_{25}	birth_dev	1	1										
X_{26}	fear_level	-1	1	1									
X_{27}	desire_sup	1											
X_{28}	ask_sup	1											
X_{29}	birth_dev_det$_{HCP}$	1	1										
X_{30}	det_risk_level$_{HCP}$	X_{53}											
X_{31}	encourage_mom$_{HCP}$	X_{54}											
X_{32}	calm_dad$_{HCP}$	1	X_{55}										
X_{33}	irr_birth_weight$_{HCP}$	1	2										
X_{34}	det_underw$_{HCP}$	X_{56}											
X_{35}	refer_mom_ther$_{HCP}$	X_{57}											
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{58}											
X_{37}	baby_born$_{HCP}$	1											
X_{38}	type_com$_{HCP}$	X_{59}											
X_{39}	type_mom$_{HCP}$	1											
X_{40}	pre_birth_info$_{HCP}$	X_{60}											
X_{41}	birth_dev_det$_{AIC}$	1	1										
X_{42}	det_risk_level$_{AIC}$	X_{61}											
X_{43}	encourage_mom$_{AIC}$	X_{62}											
X_{44}	calm_dad$_{AIC}$	1	X_{63}										
X_{45}	irr_birth_weight$_{AIC}$	1	2										
X_{46}	det_underw$_{AIC}$	X_{64}											
X_{47}	refer_mom_ther$_{AIC}$	X_{65}											
X_{48}	teach_dad_sup_mom$_{AIC}$	X_{66}											
X_{49}	baby_born$_{AIC}$	1											
X_{50}	type_com$_{AIC}$	X_{67}											
X_{51}	type_mom$_{AIC}$	1											
X_{52}	pre_birth_info$_{AIC}$	X_{68}											
X_{53}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1											
X_{54}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1											
X_{55}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1											
X_{56}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1											
X_{57}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1											
X_{58}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1											
X_{59}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1											
X_{60}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1											
X_{61}	$\mathbf{W}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	1											
X_{62}	$\mathbf{W}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	1											
X_{63}	$\mathbf{W}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	1											
X_{64}	$\mathbf{W}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	1											
X_{65}	$\mathbf{W}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	1											
X_{66}	$\mathbf{W}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	1											
X_{67}	$\mathbf{W}_{baby\_born\_AIC,\ type\_com\_AIC}$	1											
X_{68}	$\mathbf{W}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	1											
X_{69}	$\mathbf{W}_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	1											
X_{70}	$\mathbf{W}_{calm\_dad\_AIC,\ acknowl\_fat}$	1											
X_{71}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	1											
X_{72}	$\mathbf{W}_{calm\_dad\_AIC,\ com\_sup\_hcp}$	1											
X_{73}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	1											
X_{74}	$\mathbf{W}_{calm\_dad\_AIC,\ post\_info\_com\_par}$	1											
X_{75}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	1											
X_{76}	$\mathbf{W}_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	1											
X_{77}	$\mathbf{W}_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	1											
X_{78}	$\mathbf{W}_{calm\_dad\_AIC,\ mental\_sup}$	1											
X_{79}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	1											
X_{80}	$\mathbf{W}_{encourage\_mom\_AIC,\ mental\_sup}$	1											
X_{81}	$\mathbf{W}_{refer\_mom\_ther\_AIC,\ mental\_sup}$	1											
X_{82}	$\mathbf{W}_{type\_com\_AIC,\ type\_com}$	1											
X_{83}	monitor_pre_birth_info	1	1										
X_{84}	monitor_acknowl_fat$_1$	1	1										
X_{85}	monitor_acknowl_fat$_2$	1	1										
X_{86}	monitor_com_sup_hcp$_1$	1	1										
X_{87}	monitor_com_sup_hcp$_2$	1	1										
X_{88}	monitor_post_info_com_par$_1$	1	1										
X_{89}	monitor_post_info_com_par$_2$	1	1										
X_{90}	monitor_post_info_com_par$_3$	1	1										
X_{91}	monitor_refer_therapist	1	1										
X_{92}	monitor_mental_sup$_1$	1	1										
X_{93}	monitor_mental_sup$_2$	1	1										
X_{94}	monitor_mental_sup$_3$	1	1										
X_{95}	monitor_mental_sup$_4$	1	1										
X_{96}	monitor_type_com	1	1										

Table 26 Role matrix for Case (c) for **mcfw**—combination function weights

mcfw - combination function weights		1	2
		Alogistic	Monitor
x_1	type_mom	1	
x_2	artificiality_birth	1	
x_3	epidural_used	1	
x_4	deliv_baby	1	
x_5	baby_born	1	
x_6	MPPD	1	
x_7	PPPD	1	
x_8	kid_devel	1	
x_9	pre_birth_info	1	
x_{10}	com_sup_hcp	1	
x_{11}	fat_ask_sup_com	1	
x_{12}	fat_rec_sup_com	1	
x_{13}	post_info_com_par	1	
x_{14}	refer_therapist	1	
x_{15}	mental_sup	1	
x_{16}	acknowl_fat	1	
x_{17}	age	1	
x_{18}	riskiness	1	
x_{19}	dilation_mom	1	
x_{20}	premature_birth	1	
x_{21}	type_com	1	
x_{22}	retention	1	
x_{23}	engaged	1	
x_{24}	stress	1	
x_{25}	birth_dev	1	
x_{26}	fear_level	1	
x_{27}	desire_sup	1	
x_{28}	ask_sup	1	
x_{29}	$\text{birth\_dev\_det}_{\text{HCP}}$	1	
x_{30}	$\text{det\_risk\_level}_{\text{HCP}}$	1	
x_{31}	$\text{encourage\_mom}_{\text{HCP}}$	1	
x_{32}	$\text{calm\_dad}_{\text{HCP}}$	1	
x_{33}	$\text{irr\_birth\_weight}_{\text{HCP}}$	1	
x_{34}	$\text{det\_underw}_{\text{HCP}}$	1	
x_{35}	$\text{refer\_mom\_ther}_{\text{HCP}}$	1	
x_{36}	$\text{teach\_dad\_sup\_mom}_{\text{HCP}}$	1	
x_{37}	$\text{baby\_born}_{\text{HCP}}$	1	
x_{38}	$\text{type\_com}_{\text{HCP}}$	1	
x_{39}	$\text{type\_mom}_{\text{HCP}}$	1	
x_{40}	$\text{pre\_birth\_info}_{\text{HCP}}$	1	
x_{41}	$\text{birth\_dev\_det}_{\text{AIC}}$	1	
x_{42}	$\text{det\_risk\_level}_{\text{AIC}}$	1	
x_{43}	$\text{encourage\_mom}_{\text{AIC}}$	1	
x_{44}	$\text{calm\_dad}_{\text{AIC}}$	1	
x_{45}	$\text{irr\_birth\_weight}_{\text{AIC}}$	1	
x_{46}	$\text{det\_underw}_{\text{AIC}}$	1	
x_{47}	$\text{refer\_mom\_ther}_{\text{AIC}}$	1	
x_{48}	$\text{teach\_dad\_sup\_mom}_{\text{AIC}}$	1	
x_{49}	$\text{baby\_born}_{\text{AIC}}$	1	
x_{50}	$\text{type\_com}_{\text{AIC}}$	1	
x_{51}	$\text{type\_mom}_{\text{AIC}}$	1	
x_{52}	$\text{pre\_birth\_info}_{\text{AIC}}$	1	
x_{53}	$\mathbf{w}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	1	
x_{54}	$\mathbf{w}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	1	
x_{55}	$\mathbf{w}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	1	
x_{56}	$\mathbf{w}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	1	
x_{57}	$\mathbf{w}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	1	
x_{58}	$\mathbf{w}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	1	
x_{59}	$\mathbf{w}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	1	
x_{60}	$\mathbf{w}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	1	
x_{61}	$\mathbf{w}_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	1	
x_{62}	$\mathbf{w}_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	1	
x_{63}	$\mathbf{w}_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	1	
x_{64}	$\mathbf{w}_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	1	
x_{65}	$\mathbf{w}_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	1	
x_{66}	$\mathbf{w}_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	1	
x_{67}	$\mathbf{w}_{\text{baby\_born\_AIC, type\_com\_AIC}}$	1	
x_{68}	$\mathbf{w}_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	1	
x_{69}	$\mathbf{w}_{\text{pre\_birth\_info\_AIC, pre\_birth\_info}}$	1	
x_{70}	$\mathbf{w}_{\text{calm\_dad\_AIC, acknowl\_fat}}$	1	
x_{71}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, acknowl\_fat}}$	1	
x_{72}	$\mathbf{w}_{\text{calm\_dad\_AIC, com\_sup\_hcp}}$	1	
x_{73}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, com\_sup\_hcp}}$	1	
x_{74}	$\mathbf{w}_{\text{calm\_dad\_AIC, post\_info\_com\_par}}$	1	
x_{75}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, post\_info\_com\_par}}$	1	
x_{76}	$\mathbf{w}_{\text{encourage\_mom\_AIC, post\_info\_com\_par}}$	1	
x_{77}	$\mathbf{w}_{\text{refer\_mom\_ther\_AIC, refer\_therapist}}$	1	
x_{78}	$\mathbf{w}_{\text{calm\_dad\_AIC, mental\_sup}}$	1	
x_{79}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, mental\_sup}}$	1	
x_{80}	$\mathbf{w}_{\text{encourage\_mom\_AIC, mental\_sup}}$	1	
x_{81}	$\mathbf{w}_{\text{refer\_mom\_ther\_AIC, mental\_sup}}$	1	
x_{82}	$\mathbf{w}_{\text{type\_com\_AIC, type\_com}}$	1	
x_{83}	monitor_pre_birth_info		1
x_{84}	$\text{monitor\_acknowl\_fat}_1$		1
x_{85}	$\text{monitor\_acknowl\_fat}_2$		1
x_{86}	$\text{monitor\_com\_sup\_hcp}_1$		1
x_{87}	$\text{monitor\_com\_sup\_hcp}_2$		1
x_{88}	$\text{monitor\_post\_info\_com\_par}_1$		1
x_{89}	$\text{monitor\_post\_info\_com\_par}_2$		1
x_{90}	$\text{monitor\_post\_info\_com\_par}_3$		1
x_{91}	monitor_refer_therapist		1
x_{92}	$\text{monitor\_mental\_sup}_1$		1
x_{93}	$\text{monitor\_mental\_sup}_2$		1
x_{94}	$\text{monitor\_mental\_sup}_3$		1
x_{95}	$\text{monitor\_mental\_sup}_4$		1
x_{96}	monitor_type_com		1

Table 27 Role matrix for Case (c) for **mcfp**—combination function parameters

mcfp - combination function parameters		1 Alogistic		2 Monitor
		Steepness	Threshold	Threshold
X_1	type_mom	50	0.5	
X_2	artificiality_birth	50	0.5	
X_3	epidural_used	50	0.5	
X_4	deliv_baby	5	0.5	
X_5	baby_born	50	0.5	
X_6	MPPD	5	0.3	
X_7	PPPD	5	0.5	
X_8	kid_devel	5	0.5	
X_9	pre_birth_info	50	0.5	
X_{10}	com_sup_hcp	0.5	6	
X_{11}	fat_ask_sup_com	5	1	
X_{12}	fat_rec_sup_com	5	0.5	
X_{13}	post_info_com_par	5	4	
X_{14}	refer_therapist	5	1	
X_{15}	mental_sup	5	5	
X_{16}	acknowl_fat	5	0.8	
X_{17}	age	5	0.5	
X_{18}	riskiness	50	0.5	
X_{19}	dilation_mom	2.8	0	
X_{20}	premature_birth	5	0.5	
X_{21}	type_com	5	0.1	
X_{22}	retention	5	0.3	
X_{23}	engaged	5	0.5	
X_{24}	stress	5	0.5	
X_{25}	birth_dev	50	1	
X_{26}	fear_level	5	1	
X_{27}	desire_sup	5	0.3	
X_{28}	ask_sup	5	0.2	
X_{29}	birth_dev_det$_{HCP}$	5	1	
X_{30}	det_risk_level$_{HCP}$	5	0.5	
X_{31}	encourage_mom$_{HCP}$	5	0.5	
X_{32}	calm_dad$_{HCP}$	50	0.7	
X_{33}	irr_birth_weight$_{HCP}$	5	1	
X_{34}	det_underw$_{HCP}$	5	0.5	
X_{35}	refer_mom_ther$_{HCP}$	50	0.5	
X_{36}	teach_dad_sup_mom$_{HCP}$	50	0.7	
X_{37}	baby_born$_{HCP}$	5	0.5	
X_{38}	type_com$_{HCP}$	50	0.5	
X_{39}	type_mom$_{HCP}$	5	0.5	
X_{40}	pre_birth_info$_{HCP}$	50	0.5	
X_{41}	birth_dev_det$_{AIC}$	5	1	
X_{42}	det_risk_level$_{AIC}$	5	0.5	
X_{43}	encourage_mom$_{AIC}$	5	0.5	
X_{44}	calm_dad$_{AIC}$	50	0.7	
X_{45}	irr_birth_weight$_{AIC}$	5	1	
X_{46}	det_underw$_{AIC}$	5	0.5	
X_{47}	refer_mom_ther$_{AIC}$	50	0.5	
X_{48}	teach_dad_sup_mom$_{AIC}$	50	0.7	
X_{49}	baby_born$_{AIC}$	5	0.5	
X_{50}	type_com$_{AIC}$	50	0.5	
X_{51}	type_mom$_{AIC}$	5	0.5	
X_{52}	pre_birth_info$_{AIC}$	50	0.5	
X_{53}	$W_{birth\_dev,\ det\_HCP,\ det\_risk\_level\_HCP}$	5	0.5	
X_{54}	$W_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	5	0.5	
X_{55}	$W_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	5	0.5	
X_{56}	$W_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	5	0.5	
X_{57}	$W_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	5	0.5	
X_{58}	$W_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	5	0.5	
X_{59}	$W_{baby\_born\_HCP,\ type\_com\_HCP}$	5	0.5	
X_{60}	$W_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	5	0.5	
X_{61}	$W_{birth\_dev,\ det\_AIC,\ det\_risk\_level\_AIC}$	5	0.5	
X_{62}	$W_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	5	0.5	
X_{63}	$W_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	5	0.5	
X_{64}	$W_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	5	0.5	
X_{65}	$W_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	5	0.5	
X_{66}	$W_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	5	0.5	
X_{67}	$W_{baby\_born\_AIC,\ type\_com\_AIC}$	5	0.5	
X_{68}	$W_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	5	0.5	
X_{69}	$W_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	5	0.5	
X_{70}	$W_{calm\_dad\_AIC,\ acknowl\_fat}$	5	0.5	
X_{71}	$W_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	5	0.5	
X_{72}	$W_{calm\_dad\_AIC,\ com\_sup\_hcp}$	5	0.5	
X_{73}	$W_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	5	0.5	
X_{74}	$W_{calm\_dad\_AIC,\ post\_info\_com\_par}$	5	0.5	
X_{75}	$W_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	5	0.5	
X_{76}	$W_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	5	0.5	
X_{77}	$W_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	5	0.5	
X_{78}	$W_{calm\_dad\_AIC,\ mental\_sup}$	5	0.5	
X_{79}	$W_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	5	0.5	
X_{80}	$W_{encourage\_mom\_AIC,\ mental\_sup}$	5	0.5	
X_{81}	$W_{refer\_mom\_ther\_AIC,\ mental\_sup}$	5	0.5	
X_{82}	$W_{type\_com\_AIC,\ type\_com}$	5	0.5	
X_{83}	monitor_pre_birth_info			0.6
X_{84}	monitor_acknowl_fat$_1$			0.6
X_{85}	monitor_acknowl_fat$_2$			0.6
X_{86}	monitor_com_sup_hcp$_1$			0.6
X_{87}	monitor_com_sup_hcp$_2$			0.6
X_{88}	monitor_post_info_com_par$_1$			0.6
X_{89}	monitor_post_info_com_par$_2$			0.6
X_{90}	monitor_post_info_com_par$_3$			0.6
X_{91}	monitor_refer_therapist			0.6
X_{92}	monitor_mental_sup$_1$			0.6
X_{93}	monitor_mental_sup$_2$			0.6
X_{94}	monitor_mental_sup$_3$			0.6
X_{95}	monitor_mental_sup$_4$			0.6
X_{96}	monitor_type_com			0.6

Table 28 Role matrix for Case (c) for **iv**—initial values

	iv – initial values	1
x_1	type_mom	0
x_2	artificiality_birth	0
x_3	epidural_used	0
x_4	deliv_baby	0
x_5	baby_born	0
x_6	MPPD	0.13
x_7	PPPD	0
x_8	kid_devel	0
x_9	pre_birth_info	0
x_{10}	com_sup_hcp	0
x_{11}	fat_ask_sup_com	0
x_{12}	fat_rec_sup_com	0
x_{13}	post_info_com_par	0
x_{14}	refer_therapist	0
x_{15}	mental_sup	0
x_{16}	acknowl_fat	0
x_{17}	age	1
x_{18}	riskiness	0
x_{19}	dilation_mom	0.2
x_{20}	premature_birth	1
x_{21}	type_com	0
x_{22}	retention	0
x_{23}	engaged	0
x_{24}	stress	0
x_{25}	birth_dev	0
x_{26}	fear_level	0
x_{27}	desire_sup	0
x_{28}	ask_sup	0
x_{29}	$\text{birth\_dev\_det}_{\text{HCP}}$	0
x_{30}	$\text{det\_risk\_level}_{\text{HCP}}$	0
x_{31}	$\text{encourage\_mom}_{\text{HCP}}$	0
x_{32}	$\text{calm\_dad}_{\text{HCP}}$	0
x_{33}	$\text{irr\_birth\_weight}_{\text{HCP}}$	0
x_{34}	$\text{det\_underw}_{\text{HCP}}$	0
x_{35}	$\text{refer\_mom\_ther}_{\text{HCP}}$	0
x_{36}	$\text{teach\_dad\_sup\_mom}_{\text{HCP}}$	0
x_{37}	$\text{baby\_born}_{\text{HCP}}$	0
x_{38}	$\text{type\_com}_{\text{HCP}}$	0
x_{39}	$\text{type\_mom}_{\text{HCP}}$	0
x_{40}	$\text{pre\_birth\_info}_{\text{HCP}}$	0
x_{41}	$\text{birth\_dev\_det}_{\text{AIC}}$	0
x_{42}	$\text{det\_risk\_level}_{\text{AIC}}$	0
x_{43}	$\text{encourage\_mom}_{\text{AIC}}$	0
x_{44}	$\text{calm\_dad}_{\text{AIC}}$	0
x_{45}	$\text{irr\_birth\_weight}_{\text{AIC}}$	0
x_{46}	$\text{det\_underw}_{\text{AIC}}$	0
x_{47}	$\text{refer\_mom\_ther}_{\text{AIC}}$	0
x_{48}	$\text{teach\_dad\_sup\_mom}_{\text{AIC}}$	0
x_{49}	$\text{baby\_born}_{\text{AIC}}$	0
x_{50}	$\text{type\_com}_{\text{AIC}}$	0
x_{51}	$\text{type\_mom}_{\text{AIC}}$	0
x_{52}	$\text{pre\_birth\_info}_{\text{AIC}}$	0
x_{53}	$\mathbf{w}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	0
x_{54}	$\mathbf{w}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	0
x_{55}	$\mathbf{w}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	0
x_{56}	$\mathbf{w}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	0
x_{57}	$\mathbf{w}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	0
x_{58}	$\mathbf{w}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	0
x_{59}	$\mathbf{w}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	0
x_{60}	$\mathbf{w}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	0
x_{61}	$\mathbf{w}_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	1
x_{62}	$\mathbf{w}_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	1
x_{63}	$\mathbf{w}_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	1
x_{64}	$\mathbf{w}_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	1
x_{65}	$\mathbf{w}_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	1
x_{66}	$\mathbf{w}_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	1
x_{67}	$\mathbf{w}_{\text{baby\_born\_AIC, type\_com\_AIC}}$	1
x_{68}	$\mathbf{w}_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	1
x_{69}	$\mathbf{w}_{\text{pre\_birth\_info\_AIC, pre\_birth\_info}}$	0
x_{70}	$\mathbf{w}_{\text{calm\_dad\_AIC, acknowl\_fat}}$	0
x_{71}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, acknowl\_fat}}$	0
x_{72}	$\mathbf{w}_{\text{calm\_dad\_AIC, com\_sup\_hcp}}$	0
x_{73}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, com\_sup\_hcp}}$	0
x_{74}	$\mathbf{w}_{\text{calm\_dad\_AIC, post\_info\_com\_par}}$	0
x_{75}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, post\_info\_com\_par}}$	0
x_{76}	$\mathbf{w}_{\text{encourage\_mom\_AIC, post\_info\_com\_par}}$	0
x_{77}	$\mathbf{w}_{\text{refer\_mom\_ther\_AIC, refer\_therapist}}$	0
x_{78}	$\mathbf{w}_{\text{calm\_dad\_AIC, mental\_sup}}$	0
x_{79}	$\mathbf{w}_{\text{teach\_dad\_sup\_mom\_AIC, mental\_sup}}$	0
x_{80}	$\mathbf{w}_{\text{encourage\_mom\_AIC, mental\_sup}}$	0
x_{81}	$\mathbf{w}_{\text{refer\_mom\_ther\_AIC, mental\_sup}}$	0
x_{82}	$\mathbf{w}_{\text{type\_com\_AIC, type\_com}}$	0
x_{83}	monitor_pre_birth_info	0
x_{84}	$\text{monitor\_acknowl\_fat}_1$	0
x_{85}	$\text{monitor\_acknowl\_fat}_2$	0
x_{86}	$\text{monitor\_com\_sup\_hcp}_1$	0
x_{87}	$\text{monitor\_com\_sup\_hcp}_2$	0
x_{88}	$\text{monitor\_post\_info\_com\_par}_1$	0
x_{89}	$\text{monitor\_post\_info\_com\_par}_2$	0
x_{90}	$\text{monitor\_post\_info\_com\_par}_3$	0
x_{91}	monitor_refer_therapist	0
x_{92}	$\text{monitor\_mental\_sup}_1$	0
x_{93}	$\text{monitor\_mental\_sup}_2$	0
x_{94}	$\text{monitor\_mental\_sup}_3$	0
x_{95}	$\text{monitor\_mental\_sup}_4$	0
x_{96}	monitor_type_com	0

Table 29 Role matrix for Case (c) for **ms**—speed factors

	ms - speed factors	1
x_1	type_mom	1
x_2	artificiality_birth	1
x_3	epidural_used	1
x_4	deliv_baby	0.2
x_5	baby_born	0.1
x_6	MPPD	0.2
x_7	PPPD	1
x_8	kid_devel	1
x_9	pre_birth_info	0.1
x_{10}	com_sup_hcp	0.1
x_{11}	fat_ask_sup_com	0.3
x_{12}	fat_rec_sup_com	0.1
x_{13}	post_info_com_par	0.1
x_{14}	refer_therapist	0.3
x_{15}	mental_sup	0.1
x_{16}	acknowl_fat	0.1
x_{17}	age	0
x_{18}	riskiness	0.5
x_{19}	dilation_mom	1
x_{20}	premature_birth	0
x_{21}	type_com	1
x_{22}	retention	1
x_{23}	engaged	1
x_{24}	stress	0.4
x_{25}	birth_dev	1
x_{26}	fear_level	1
x_{27}	desire_sup	1
x_{28}	ask_sup	0.2
x_{29}	$birth\_dev\_det_{HCP}$	1
x_{30}	$det\_risk\_level_{HCP}$	1
x_{31}	$encourage\_mom_{HCP}$	0.1
x_{32}	$calm\_dad_{HCP}$	0.1
x_{33}	$irr\_birth\_weight_{HCP}$	1
x_{34}	det_underw_{HCP}	1
x_{35}	$refer\_mom\_ther_{HCP}$	0.3
x_{36}	$teach\_dad\_sup\_mom_{HCP}$	0.1
x_{37}	$baby\_born_{HCP}$	1
x_{38}	$type\_com_{HCP}$	1
x_{39}	$type\_mom_{HCP}$	1
x_{40}	$pre\_birth\_info_{HCP}$	1
x_{41}	$birth\_dev\_det_{AIC}$	0.33
x_{42}	$det\_risk\_level_{AIC}$	0.33
x_{43}	$encourage\_mom_{AIC}$	0.033
x_{44}	$calm\_dad_{AIC}$	0.033
x_{45}	$irr\_birth\_weight_{AIC}$	0.33
x_{46}	det_underw_{AIC}	0.33
x_{47}	$refer\_mom\_ther_{AIC}$	0.1
x_{48}	$teach\_dad\_sup\_mom_{AIC}$	0.033
x_{49}	$baby\_born_{AIC}$	0.33
x_{50}	$type\_com_{AIC}$	0.33
x_{51}	$type\_mom_{AIC}$	0.33
x_{52}	$pre\_birth\_info_{AIC}$	0.33
x_{53}	$w_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	0
x_{54}	$w_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	0
x_{55}	$w_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	0
x_{56}	$w_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	0
x_{57}	$w_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	0
x_{58}	$w_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	0
x_{59}	$w_{baby\_born\_HCP,\ type\_com\_HCP}$	0
x_{60}	$w_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	0
x_{61}	$w_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	0
x_{62}	$w_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	0
x_{63}	$w_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	0
x_{64}	$w_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	0
x_{65}	$w_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	0
x_{66}	$w_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	0
x_{67}	$w_{baby\_born\_AIC,\ type\_com\_AIC}$	0
x_{68}	$w_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	0
x_{69}	$w_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	0
x_{70}	$w_{calm\_dad\_AIC,\ acknowl\_fat}$	0.5
x_{71}	$w_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	0.5
x_{72}	$w_{calm\_dad\_AIC,\ com\_sup\_hcp}$	0.5
x_{73}	$w_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	0.5
x_{74}	$w_{calm\_dad\_AIC,\ post\_info\_com\_par}$	0.5
x_{75}	$w_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	0.5
x_{76}	$w_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	0.5
x_{77}	$w_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	0.5
x_{78}	$w_{calm\_dad\_AIC,\ mental\_sup}$	0.5
x_{79}	$w_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	0.5
x_{80}	$w_{encourage\_mom\_AIC,\ mental\_sup}$	0.5
x_{81}	$w_{refer\_mom\_ther\_AIC,\ mental\_sup}$	0.5
x_{82}	$w_{type\_com\_AIC,\ type\_com}$	0.5
x_{83}	monitor_pre_birth_info	0.5
x_{84}	$monitor\_acknowl\_fat_1$	0.5
x_{85}	$monitor\_acknowl\_fat_2$	0.5
x_{86}	$monitor\_com\_sup\_hcp_1$	0.5
x_{87}	$monitor\_com\_sup\_hcp_2$	0.5
x_{88}	$monitor\_post\_info\_com\_par_1$	0.5
x_{89}	$monitor\_post\_info\_com\_par_2$	0.5
x_{90}	$monitor\_post\_info\_com\_par_3$	0.5
x_{91}	monitor_refer_therapist	0.5
x_{92}	$monitor\_mental\_sup_1$	0.5
x_{93}	$monitor\_mental\_sup_2$	0.5
x_{94}	$monitor\_mental\_sup_3$	0.5
x_{95}	$monitor\_mental\_sup_4$	0.5
x_{96}	monitor_type_com	0.5

Table 30 Role matrix for Case (d) for **mb**—base connectivity

	mb - base connectivity	1	2	3	4	5	6	7	8	9	10	11	12
X_1	type_mom	X_1											
X_2	artificiality_birth	X_2	X_{18}										
X_3	epidural_used	X_3											
X_4	deliv_baby	X_4	X_{19}										
X_5	baby_born	X_4											
X_6	MIPPD	X_1	X_2	X_3	X_6	X_{15}							
X_7	PPPD	X_6	X_{10}	X_{12}	X_{15}	X_{23}	X_{24}						
X_8	imp_kid_devel	X_3											
X_9	pre_birth_info	X_9	X_{40}	X_{12}									
X_{10}	com_sup_hcp	X_4	X_9	X_{11}	X_{24}	X_{10}	X_{12}	X_{14}	X_{16}	X_{42}	X_{44}	X_{46}	X_{48}
X_{11}	fat_ask_sup_com	X_{33}	X_{28}										
X_{12}	fat_rec_sup_com	X_{10}	X_{22}	X_{34}									
X_{13}	post_info_com_par	X_6	X_{20}	X_{31}	X_{32}	X_{36}	X_{43}	X_{44}	X_{48}				
X_{14}	refer_therapist	X_{13}	X_{35}	X_{47}									
X_{15}	mental_sup	X_{14}	X_{21}	X_{33}	X_{32}	X_{35}	X_{36}	X_{43}	X_{44}	X_{47}	X_{48}		
X_{16}	acknowl_fat	X_6	X_{32}	X_{36}	X_{44}	X_{48}							
X_{17}	age	X_{17}											
X_{18}	riskiness	X_6	X_{17}										
X_{19}	dilation_mom	X_{19}											
X_{20}	premature_birth	X_{20}											
X_{21}	type_com	X_{21}	X_{38}	X_{40}									
X_{22}	retention	X_{33}	X_{24}										
X_{23}	engaged	X_{16}											
X_{24}	stress	X_{16}											
X_{25}	birth_dev	X_4	X_{18}										
X_{26}	fear_level	X_{33}	X_{26}	X_{31}									
X_{27}	desire_sup	X_{16}											
X_{28}	ask_sup	X_{27}											
X_{29}	birth_dev_det$_{HCP}$	X_4	X_{18}										
X_{30}	det_risk_level$_{HCP}$	X_{39}											
X_{31}	encourage_mom$_{HCP}$	X_{30}											
X_{32}	calm_dad$_{HCP}$	X_{11}	X_{30}										
X_{33}	irr_birth_weight$_{HCP}$	X_6	X_{20}										
X_{34}	det_underw$_{HCP}$	X_{33}											
X_{35}	refer_mom_ther$_{HCP}$	X_{44}											
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{44}											
X_{37}	baby_born$_{HCP}$	X_5											
X_{38}	type_com$_{HCP}$	X_{21}											
X_{39}	type_mom$_{HCP}$	X_1											
X_{40}	pre_birth_info$_{HCP}$	X_{39}											
X_{41}	birth_dev_det$_{AIC}$	X_4	X_{18}										
X_{42}	det_risk_level$_{AIC}$	X_{41}											
X_{43}	encourage_mom$_{AIC}$	X_{42}											
X_{44}	calm_dad$_{AIC}$	X_{11}	X_{42}										
X_{45}	irr_birth_weight$_{AIC}$	X_6	X_{20}										
X_{46}	det_underw$_{AIC}$	X_{45}											
X_{47}	refer_mom_ther$_{AIC}$	X_{46}											
X_{48}	teach_dad_sup_mom$_{AIC}$	X_{46}											
X_{49}	baby_born$_{AIC}$	X_5											
X_{50}	type_com$_{AIC}$	X_{49}											
X_{51}	type_mom$_{AIC}$	X_1											
X_{52}	pre_birth_info$_{AIC}$	X_{51}											
X_{53}	$\mathbf{W}_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	X_{53}	X_{61}										
X_{54}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	X_{54}	X_{62}										
X_{55}	$\mathbf{W}_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	X_{55}	X_{63}										
X_{56}	$\mathbf{W}_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	X_{56}	X_{64}										
X_{57}	$\mathbf{W}_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	X_{57}	X_{65}										
X_{58}	$\mathbf{W}_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	X_{58}	X_{66}										
X_{59}	$\mathbf{W}_{\text{baby\_born\_HCP, type\_com\_HCP}}$	X_{59}	X_{67}										
X_{60}	$\mathbf{W}_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	X_{60}	X_{68}										
X_{61}	$\mathbf{W}_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	X_{61}	X_{69}										
X_{62}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	X_{62}	X_{100}										
X_{63}	$\mathbf{W}_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	X_{63}	X_{101}										
X_{64}	$\mathbf{W}_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	X_{64}	X_{102}										
X_{65}	$\mathbf{W}_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	X_{65}	X_{103}										
X_{66}	$\mathbf{W}_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	X_{66}	X_{104}										
X_{67}	$\mathbf{W}_{\text{baby\_born\_AIC, type\_com\_AIC}}$	X_{67}	X_{105}										
X_{68}	$\mathbf{W}_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	X_{68}	X_{106}										
X_{69}	$\mathbf{W}_{\text{pre\_birth\_info\_AIC, pre\_birth\_info}}$	X_{69}											
X_{70}	$\mathbf{W}_{\text{calm\_dad\_AIC, acknowl\_fat}}$	X_{65}											
X_{71}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, acknowl\_fat}}$	X_{66}											
X_{72}	$\mathbf{W}_{\text{calm\_dad\_AIC, com\_sup\_hcp}}$	X_{65}											
X_{73}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, com\_sup\_hcp}}$	X_{67}											
X_{74}	$\mathbf{W}_{\text{calm\_dad\_AIC, post\_info\_com\_par}}$	X_{69}											
X_{75}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, post\_info\_com\_par}}$	X_{70}											
X_{76}	$\mathbf{W}_{\text{encourage\_mom\_AIC, post\_info\_com\_par}}$	X_{68}											
X_{77}	$\mathbf{W}_{\text{refer\_mom\_ther\_AIC, refer\_therapist}}$	X_{63}											
X_{78}	$\mathbf{W}_{\text{calm\_dad\_AIC, mental\_sup}}$	X_{64}											
X_{79}	$\mathbf{W}_{\text{teach\_dad\_sup\_mom\_AIC, mental\_sup}}$	X_{65}											
X_{80}	$\mathbf{W}_{\text{encourage\_mom\_AIC, mental\_sup}}$	X_{62}											
X_{81}	$\mathbf{W}_{\text{refer\_mom\_ther\_AIC, mental\_sup}}$	X_{63}											
X_{82}	$\mathbf{W}_{\text{type\_com\_AIC, type\_com}}$	X_{66}											
X_{83}	monitor_pre_birth_info	X_{13}	X_9										
X_{84}	monitor_acknowl_fat$_1$	X_{68}	X_{16}										
X_{85}	monitor_acknowl_fat$_2$	X_{68}	X_{16}										
X_{86}	monitor_com_sup_hcp$_1$	X_{68}	X_{10}										
X_{87}	monitor_com_sup_hcp$_2$	X_{68}	X_{10}										
X_{88}	monitor_post_info_com_par$_1$	X_{13}	X_{13}										
X_{89}	monitor_post_info_com_par$_2$	X_{68}	X_{13}										
X_{90}	monitor_post_info_com_par$_3$	X_{68}	X_{13}										
X_{91}	monitor_refer_therapist	X_{13}	X_{14}										
X_{92}	monitor_mental_sup$_1$	X_{13}	X_{15}										
X_{93}	monitor_mental_sup$_2$	X_{37}	X_{15}										
X_{94}	monitor_mental_sup$_3$	X_{68}	X_{15}										
X_{95}	monitor_mental_sup$_4$	X_{68}	X_{15}										
X_{96}	monitor_type_com	X_{60}	X_{21}										
X_{97}	$\mathbf{W}_{\text{W\_A/C, W\_HCP}}$	X_{68}											
X_{98}	con_feedback	X_{68}											
X_{99}	$\mathbf{W}_{\text{birth\_dev\_det\_E, det\_risk\_level\_E}}$												
X_{100}	$\mathbf{W}_{\text{det\_risk\_level\_E, encourage\_mom\_E}}$												
X_{101}	$\mathbf{W}_{\text{det\_risk\_level\_E, calm\_dad\_E}}$												
X_{102}	$\mathbf{W}_{\text{irr\_birth\_weight\_E, det\_underw\_E}}$												
X_{103}	$\mathbf{W}_{\text{det\_underw\_E, refer\_mom\_ther\_E}}$												
X_{104}	$\mathbf{W}_{\text{det\_underw\_E, teach\_dad\_sup\_mom\_E}}$												
X_{105}	$\mathbf{W}_{\text{baby\_born\_E, type\_com\_E}}$												
X_{106}	$\mathbf{W}_{\text{type\_mom\_E, pre\_birth\_info\_E}}$												
X_{107}	$\mathbf{W}_{\text{W\_E,W\_A/C}}$	X_{108}											
X_{108}	con_feedforward	X_{108}											

Table 31 Role matrix for Case (d) for **mcw**—connection weights

mcw - connection weights		1	2	3	4	5	6	7	8	9	10	11	12
X_1	type_mom	1											
X_2	artificiality_birth	1	-1										
X_3	epidural_used	1											
X_4	deliv_baby	1	1										
X_5	baby_born	1											
X_6	MPPD	0.25	0.25	0.25	0.25	-1							
X_7	PPPD	1	-0.5	-0.5	-0.5	-0.5	1						
X_8	kid_devel	1											
X_9	pre_birth_info	1	1	X_{69}									
X_{10}	com_sup_hcp	1	1	1	-1	1	1	1	1	1	X_{72}	1	X_{73}
X_{11}	fat_ask_sup_com	1	1										
X_{12}	fat_rec_sup_com	1	1	-1									
X_{13}	post_info_com_par	1	1	1	1	1	X_{76}	X_{74}	X_{75}				
X_{14}	refer_therapist	1	1	X_{77}									
X_{15}	mental_sup	1	1	1	1	1	1	X_{80}	X_{78}	X_{81}	X_{79}		
X_{16}	acknowl_fat	1	1	1	X_{70}	X_{71}							
X_{17}	age	1											
X_{18}	riskiness	-1	1										
X_{19}	dilation_mom	1											
X_{20}	premature_birth	1											
X_{21}	type_com	1	1	X_{82}									
X_{22}	retention	2	-1										
X_{23}	engaged	1											
X_{24}	stress	1											
X_{25}	birth_dev	1	1										
X_{26}	fear_level	-1	1	1									
X_{27}	desire_sup	1											
X_{28}	ask_sup	1											
X_{29}	birth_dev_det$_{HCP}$	1	1										
X_{30}	det_risk_level$_{HCP}$	X_{53}											
X_{31}	encourage_mom$_{HCP}$	X_{54}											
X_{32}	calm_dad$_{HCP}$	1	X_{55}										
X_{33}	irr_birth_weight$_{HCP}$	1	2										
X_{34}	det_underw$_{HCP}$	X_{56}											
X_{35}	refer_mom_ther$_{HCP}$	X_{57}											
X_{36}	teach_dad_sup_mom$_{HCP}$	X_{58}											
X_{37}	baby_born$_{HCP}$	1											
X_{38}	type_com$_{HCP}$	X_{59}											
X_{39}	type_mom$_{HCP}$	1											
X_{40}	pre_birth_info$_{HCP}$	X_{60}											
X_{41}	birth_dev_det$_{AIC}$	1	1										
X_{42}	det_risk_level$_{AIC}$	X_{61}											
X_{43}	encourage_mom$_{AIC}$	X_{62}											
X_{44}	calm_dad$_{AIC}$	1	X_{63}										
X_{45}	irr_birth_weight$_{AIC}$	1	2										
X_{46}	det_underw$_{AIC}$	X_{64}											
X_{47}	refer_mom_ther$_{AIC}$	X_{65}											
X_{48}	teach_dad_sup_mom$_{AIC}$	X_{66}											
X_{49}	baby_born$_{AIC}$	1											
X_{50}	type_com$_{AIC}$	X_{67}											
X_{51}	type_mom$_{AIC}$	1											
X_{52}	pre_birth_info$_{AIC}$	X_{68}											
X_{53}	$\mathbf{W}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1	X_{83}										
X_{54}	$\mathbf{W}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1	X_{83}										
X_{55}	$\mathbf{W}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1	X_{83}										
X_{56}	$\mathbf{W}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1	X_{83}										
X_{57}	$\mathbf{W}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1	X_{83}										
X_{58}	$\mathbf{W}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1	X_{83}										
X_{59}	$\mathbf{W}_{baby\_born\_HCP,\ type\_com\_HCP}$	1	X_{83}										
X_{60}	$\mathbf{W}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1	X_{83}										
X_{61}	$\mathbf{W}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	1	X_{107}										
X_{62}	$\mathbf{W}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	1	X_{107}										
X_{63}	$\mathbf{W}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	1	X_{107}										
X_{64}	$\mathbf{W}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	1	X_{107}										
X_{65}	$\mathbf{W}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	1	X_{107}										
X_{66}	$\mathbf{W}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	1	X_{107}										
X_{67}	$\mathbf{W}_{baby\_born\_AIC,\ type\_com\_AIC}$	1	X_{107}										
X_{68}	$\mathbf{W}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	1	X_{107}										
X_{69}	$\mathbf{W}_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	1											
X_{70}	$\mathbf{W}_{calm\_dad\_AIC,\ acknowl\_fat}$	1											
X_{71}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	1											
X_{72}	$\mathbf{W}_{calm\_dad\_AIC,\ com\_sup\_hcp}$	1											
X_{73}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	1											
X_{74}	$\mathbf{W}_{calm\_dad\_AIC,\ post\_info\_com\_par}$	1											
X_{75}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	1											
X_{76}	$\mathbf{W}_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	1											
X_{77}	$\mathbf{W}_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	1											
X_{78}	$\mathbf{W}_{calm\_dad\_AIC,\ mental\_sup}$	1											
X_{79}	$\mathbf{W}_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	1											
X_{80}	$\mathbf{W}_{encourage\_mom\_AIC,\ mental\_sup}$	1											
X_{81}	$\mathbf{W}_{refer\_mom\_ther\_AIC,\ mental\_sup}$	1											
X_{82}	$\mathbf{W}_{type\_com\_AIC,\ type\_com}$	1											
X_{83}	monitor_pre_birth_info	1	1										
X_{84}	monitor_acknowl_fat$_1$	1	1										
X_{85}	monitor_acknowl_fat$_2$	1	1										
X_{86}	monitor_com_sup_hcp$_1$	1	1										
X_{87}	monitor_com_sup_hcp$_2$	1	1										
X_{88}	monitor_post_info_com_par$_1$	1	1										
X_{89}	monitor_post_info_com_par$_2$	1	1										
X_{90}	monitor_post_info_com_par$_3$	1	1										
X_{91}	monitor_refer_therapist	1	1										
X_{92}	monitor_mental_sup$_1$	1	1										
X_{93}	monitor_mental_sup$_2$	1	1										
X_{94}	monitor_mental_sup$_3$	1	1										
X_{95}	monitor_mental_sup$_4$	1	1										
X_{96}	monitor_type_com	1	1										
X_{97}	$\mathbf{W}_{\mathbf{W}\_AIC,\mathbf{W}\_HCP}$	1											
X_{98}	con_feedback	1											
X_{99}	$\mathbf{W}_{birth\_dev\_det\_E,\ det\_risk\_level\_E}$												
X_{100}	$\mathbf{W}_{det\_risk\_level\_E,\ encourage\_mom\_E}$												
X_{101}	$\mathbf{W}_{det\_risk\_level\_E,\ calm\_dad\_E}$												
X_{102}	$\mathbf{W}_{irr\_birth\_weight\_E,\ det\_underw\_E}$												
X_{103}	$\mathbf{W}_{det\_underw\_E,\ refer\_mom\_ther\_E}$												
X_{104}	$\mathbf{W}_{det\_underw\_E,\ teach\_dad\_sup\_mom\_E}$												
X_{105}	$\mathbf{W}_{baby\_born\_E,\ type\_com\_E}$												
X_{106}	$\mathbf{W}_{type\_mom\_E,\ pre\_birth\_info\_E}$												
X_{107}	$\mathbf{W}_{\mathbf{W}\_E,\mathbf{W}\_AIC}$	1											
X_{108}	con_feedforward	1											

Table 32 Role matrix for Case (d) for **mcfw**—combination function weights

mcfw - combination function weights		1	2	3
		Alogistic	Monitor	Steponce
x_1	type_mom	1		
x_2	artificiality_birth	1		
x_3	epidural_used	1		
x_4	deliv_baby	1		
x_5	baby_born	1		
x_6	MPPD	1		
x_7	PPPD	1		
x_8	kid_devel	1		
x_9	pre_birth_info	1		
x_{10}	com_sup_hcp	1		
x_{11}	fat_ask_sup_com	1		
x_{12}	fat_rec_sup_com	1		
x_{13}	post_info_com_par	1		
x_{14}	refer_therapist	1		
x_{15}	mental_sup	1		
x_{16}	acknowl_fat	1		
x_{17}	age	1		
x_{18}	riskiness	1		
x_{19}	dilation_mom	1		
x_{20}	premature_birth	1		
x_{21}	type_com	1		
x_{22}	retention	1		
x_{23}	engaged	1		
x_{24}	stress	1		
x_{25}	birth_dev	1		
x_{26}	fear_level	1		
x_{27}	desire_sup	1		
x_{28}	ask_sup	1		
x_{29}	$\text{birth\_dev\_det}_{HCP}$	1		
x_{30}	$\text{det\_risk\_level}_{HCP}$	1		
x_{31}	$\text{encourage\_mom}_{HCP}$	1		
x_{32}	calm_dad_{HCP}	1		
x_{33}	$\text{irr\_birth\_weight}_{HCP}$	1		
x_{34}	det_underw_{HCP}	1		
x_{35}	$\text{refer\_mom\_ther}_{HCP}$	1		
x_{36}	$\text{teach\_dad\_sup\_mom}_{HCP}$	1		
x_{37}	baby_born_{HCP}	1		
x_{38}	type_com_{HCP}	1		
x_{39}	type_mom_{HCP}	1		
x_{40}	$\text{pre\_birth\_info}_{HCP}$	1		
x_{41}	$\text{birth\_dev\_det}_{AIC}$	1		
x_{42}	$\text{det\_risk\_level}_{AIC}$	1		
x_{43}	$\text{encourage\_mom}_{AIC}$	1		
x_{44}	calm_dad_{AIC}	1		
x_{45}	$\text{irr\_birth\_weight}_{AIC}$	1		
x_{46}	det_underw_{AIC}	1		
x_{47}	$\text{refer\_mom\_ther}_{AIC}$	1		
x_{48}	$\text{teach\_dad\_sup\_mom}_{AIC}$	1		
x_{49}	baby_born_{AIC}	1		
x_{50}	type_com_{AIC}	1		
x_{51}	type_mom_{AIC}	1		
x_{52}	$\text{pre\_birth\_info}_{AIC}$	1		
x_{53}	$w_{\text{birth\_dev\_det\_HCP, det\_risk\_level\_HCP}}$	1		
x_{54}	$w_{\text{det\_risk\_level\_HCP, encourage\_mom\_HCP}}$	1		
x_{55}	$w_{\text{det\_risk\_level\_HCP, calm\_dad\_HCP}}$	1		
x_{56}	$w_{\text{irr\_birth\_weight\_HCP, det\_underw\_HCP}}$	1		
x_{57}	$w_{\text{det\_underw\_HCP, refer\_mom\_ther\_HCP}}$	1		
x_{58}	$w_{\text{det\_underw\_HCP, teach\_dad\_sup\_mom\_HCP}}$	1		
x_{59}	$w_{\text{baby\_born\_HCP, type\_com\_HCP}}$	1		
x_{60}	$w_{\text{type\_mom\_HCP, pre\_birth\_info\_HCP}}$	1		
x_{61}	$w_{\text{birth\_dev\_det\_AIC, det\_risk\_level\_AIC}}$	1		
x_{62}	$w_{\text{det\_risk\_level\_AIC, encourage\_mom\_AIC}}$	1		
x_{63}	$w_{\text{det\_risk\_level\_AIC, calm\_dad\_AIC}}$	1		
x_{64}	$w_{\text{irr\_birth\_weight\_AIC, det\_underw\_AIC}}$	1		
x_{65}	$w_{\text{det\_underw\_AIC, refer\_mom\_ther\_AIC}}$	1		
x_{66}	$w_{\text{det\_underw\_AIC, teach\_dad\_sup\_mom\_AIC}}$	1		
x_{67}	$w_{\text{baby\_born\_AIC, type\_com\_AIC}}$	1		
x_{68}	$w_{\text{type\_mom\_AIC, pre\_birth\_info\_AIC}}$	1		
x_{69}	$w_{\text{pre\_birth\_info\_AIC, pre\_birth\_info}}$	1		
x_{70}	$w_{\text{calm\_dad\_AIC, acknowl\_fat}}$	1		
x_{71}	$w_{\text{teach\_dad\_sup\_mom\_AIC, acknowl\_fat}}$	1		
x_{72}	$w_{\text{calm\_dad\_AIC, com\_sup\_hcp}}$	1		
x_{73}	$w_{\text{teach\_dad\_sup\_mom\_AIC, com\_sup\_hcp}}$	1		
x_{74}	$w_{\text{calm\_dad\_AIC, post\_info\_com\_par}}$	1		
x_{75}	$w_{\text{teach\_dad\_sup\_mom\_AIC, post\_info\_com\_par}}$	1		
x_{76}	$w_{\text{encourage\_mom\_AIC, post\_info\_com\_par}}$	1		
x_{77}	$w_{\text{refer\_mom\_ther\_AIC, refer\_therapist}}$	1		
x_{78}	$w_{\text{calm\_dad\_AIC, mental\_sup}}$	1		
x_{79}	$w_{\text{teach\_dad\_sup\_mom\_AIC, mental\_sup}}$	1		
x_{80}	$w_{\text{encourage\_mom\_AIC, mental\_sup}}$	1		
x_{81}	$w_{\text{refer\_mom\_ther\_AIC, mental\_sup}}$	1		
x_{82}	$w_{\text{type\_com\_AIC, type\_com}}$	1		
x_{83}	monitor_pre_birth_info		1	
x_{84}	$\text{monitor\_acknowl\_fat}_1$		1	
x_{85}	$\text{monitor\_acknowl\_fat}_2$		1	
x_{86}	$\text{monitor\_com\_sup\_hcp}_1$		1	
x_{87}	$\text{monitor\_com\_sup\_hcp}_2$		1	
x_{88}	$\text{monitor\_post\_info\_com\_par}_1$		1	
x_{89}	$\text{monitor\_post\_info\_com\_par}_2$		1	
x_{90}	$\text{monitor\_post\_info\_com\_par}_3$		1	
x_{91}	monitor_refer_therapist		1	
x_{92}	$\text{monitor\_mental\_sup}_1$		1	
x_{93}	$\text{monitor\_mental\_sup}_2$		1	
x_{94}	$\text{monitor\_mental\_sup}_3$		1	
x_{95}	$\text{monitor\_mental\_sup}_4$		1	
x_{96}	monitor_type_com		1	
x_{97}	w_{w_AIC,w_HCP}	1		
x_{98}	con_feedback			1
x_{99}	$w_{\text{birth\_dev\_det\_E, det\_risk\_level\_E}}$	1		
x_{100}	$w_{\text{det\_risk\_level\_E, encourage\_mom\_E}}$	1		
x_{101}	$w_{\text{det\_risk\_level\_E, calm\_dad\_E}}$	1		
x_{102}	$w_{\text{irr\_birth\_weight\_E, det\_underw\_E}}$	1		
x_{103}	$w_{\text{det\_underw\_E, refer\_mom\_ther\_E}}$	1		
x_{104}	$w_{\text{det\_underw\_E, teach\_dad\_sup\_mom\_E}}$	1		
x_{105}	$w_{\text{baby\_born\_E, type\_com\_E}}$	1		
x_{106}	$w_{\text{type\_mom\_E, pre\_birth\_info\_E}}$	1		
x_{107}	w_{w_E,w_AIC}	1		
x_{108}	con_feedforward	1		

Table 33 Role matrix for Case (d) for **mcfp**—combination function parameters

mcfp - combination function parameters		1 Alogistic		2 Monitor	3 Steponce	
		Steepness	Threshold	Threshold	Start Time	End Time
x_1	type_mom	50	0.5			
x_2	artificiality_birth	50	0.5			
x_3	epidural_used	50	0.5			
x_4	deliv_baby	5	0.5			
x_5	baby_born	50	0.5			
x_6	MPPD	5	0.3			
x_7	PPPD	5	0.5			
x_8	kid_devel	5	0.5			
x_9	pre_birth_info	50	0.5			
x_{10}	com_sup_hcp	0.5	8			
x_{11}	fat_ask_sup_com	5	1			
x_{12}	fat_rec_sup_com	5	0.5			
x_{13}	post_info_com_par	5	4			
x_{14}	refer_therapist	5	1			
x_{15}	mental_sup	0.5	5			
x_{16}	acknowl_fat	5	0.8			
x_{17}	age	5	0.5			
x_{18}	riskiness	50	0.5			
x_{19}	dilation_mom	2.8	0			
x_{20}	premature_birth	5	0.5			
x_{21}	type_com	5	0.1			
x_{22}	retention	5	0.3			
x_{23}	engaged	5	0.5			
x_{24}	stress	5	0.5			
x_{25}	birth_dev	50	1			
x_{26}	fear_level	5	1			
x_{27}	desire_sup	5	0.3			
x_{28}	ask_sup	5	0.2			
x_{29}	birth_dev_det$_{HCP}$	5	1			
x_{30}	det_risk_level$_{HCP}$	5	0.5			
x_{31}	encourage_mom$_{HCP}$	5	0.5			
x_{32}	calm_dad$_{HCP}$	50	0.7			
x_{33}	irr_birth_weight$_{HCP}$	5	1			
x_{34}	det_underw$_{HCP}$	5	0.5			
x_{35}	refer_mom_ther$_{HCP}$	50	0.5			
x_{36}	teach_dad_sup_mom$_{HCP}$	50	0.7			
x_{37}	baby_born$_{HCP}$	5	0.5			
x_{38}	type_com$_{HCP}$	50	0.5			
x_{39}	type_mom$_{HCP}$	5	0.5			
x_{40}	pre_birth_info$_{HCP}$	50	0.5			
x_{41}	birth_dev_det$_{AIC}$	5	1			
x_{42}	det_risk_level$_{AIC}$	5	0.5			
x_{43}	encourage_mom$_{AIC}$	5	0.5			
x_{44}	calm_dad$_{AIC}$	50	0.7			
x_{45}	irr_birth_weight$_{AIC}$	5	1			
x_{46}	det_underw$_{AIC}$	5	0.5			
x_{47}	refer_mom_ther$_{AIC}$	50	0.5			
x_{48}	teach_dad_sup_mom$_{AIC}$	50	0.7			
x_{49}	baby_born$_{AIC}$	5	0.5			
x_{50}	type_com$_{AIC}$	50	0.5			
x_{51}	type_mom$_{AIC}$	5	0.5			
x_{52}	pre_birth_info$_{AIC}$	50	0.5			
x_{53}	$w_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	5	0.5			
x_{54}	$w_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	5	0.5			
x_{55}	$w_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	5	0.5			
x_{56}	$w_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	5	0.5			
x_{57}	$w_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	5	0.5			
x_{58}	$w_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	5	0.5			
x_{59}	$w_{baby\_born\_HCP,\ type\_com\_HCP}$	5	0.5			
x_{60}	$w_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	5	0.5			
x_{61}	$w_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	5	0.5			
x_{62}	$w_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	5	0.5			
x_{63}	$w_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	5	0.5			
x_{64}	$w_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	5	0.5			
x_{65}	$w_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	5	0.5			
x_{66}	$w_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	5	0.5			
x_{67}	$w_{baby\_born\_AIC,\ type\_com\_AIC}$	5	0.5			
x_{68}	$w_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	5	0.5			
x_{69}	$w_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	5	0.5			
x_{70}	$w_{calm\_dad\_AIC,\ acknowl\_fat}$	5	0.5			
x_{71}	$w_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	5	0.5			
x_{72}	$w_{calm\_dad\_AIC,\ com\_sup\_hcp}$	5	0.5			
x_{73}	$w_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	5	0.5			
x_{74}	$w_{calm\_dad\_AIC,\ post\_info\_com\_par}$	5	0.5			
x_{75}	$w_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	5	0.5			
x_{76}	$w_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	5	0.5			
x_{77}	$w_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	5	0.5			
x_{78}	$w_{calm\_dad\_AIC,\ mental\_sup}$	5	0.5			
x_{79}	$w_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	5	0.5			
x_{80}	$w_{encourage\_mom\_AIC,\ mental\_sup}$	5	0.5			
x_{81}	$w_{refer\_mom\_ther\_AIC,\ mental\_sup}$	5	0.5			
x_{82}	$w_{type\_com\_AIC,\ type\_com}$	5	0.5			
x_{83}	monitor_pre_birth_info			0.6		
x_{84}	monitor_acknowl_fat$_1$			0.6		
x_{85}	monitor_acknowl_fat$_2$			0.6		
x_{86}	monitor_com_sup_hcp$_1$			0.6		
x_{87}	monitor_com_sup_hcp$_2$			0.6		
x_{88}	monitor_post_info_com_par$_1$			0.6		
x_{89}	monitor_post_info_com_par$_2$			0.6		
x_{90}	monitor_post_info_com_par$_3$			0.6		
x_{91}	monitor_refer_therapist			0.6		
x_{92}	monitor_mental_sup$_1$			0.6		
x_{93}	monitor_mental_sup$_2$			0.6		
x_{94}	monitor_mental_sup$_3$			0.6		
x_{95}	monitor_mental_sup$_4$			0.6		
x_{96}	monitor_type_com			0.6		
x_{97}	w_{W_AIC,W_HCP}	30	0.5			
x_{98}	con_feedback				40	80
x_{99}	$w_{birth\_dev\_det\_£,\ det\_risk\_level\_£}$	50	0.5			
x_{100}	$w_{det\_risk\_level\_£,\ encourage\_mom\_£}$	50	0.5			
x_{101}	$w_{det\_risk\_level\_£,\ calm\_dad\_£}$	50	0.5			
x_{102}	$w_{irr\_birth\_weight\_£,\ det\_underw\_£}$	50	0.5			
x_{103}	$w_{det\_underw\_£,\ refer\_mom\_ther\_£}$	50	0.5			
x_{104}	$w_{det\_underw\_£,\ teach\_dad\_sup\_mom\_£}$	50	0.5			
x_{105}	$w_{baby\_born\_£,\ type\_com\_£}$	50	0.5			
x_{106}	$w_{type\_mom\_£,\ pre\_birth\_info\_£}$	50	0.5			
x_{107}	$w_{W\_£,W\_AIC}$	50	0.5			
x_{108}	con_feedforward	5	0.5			

Table 34 Role matrix for Case (d) for **iv**——initial values

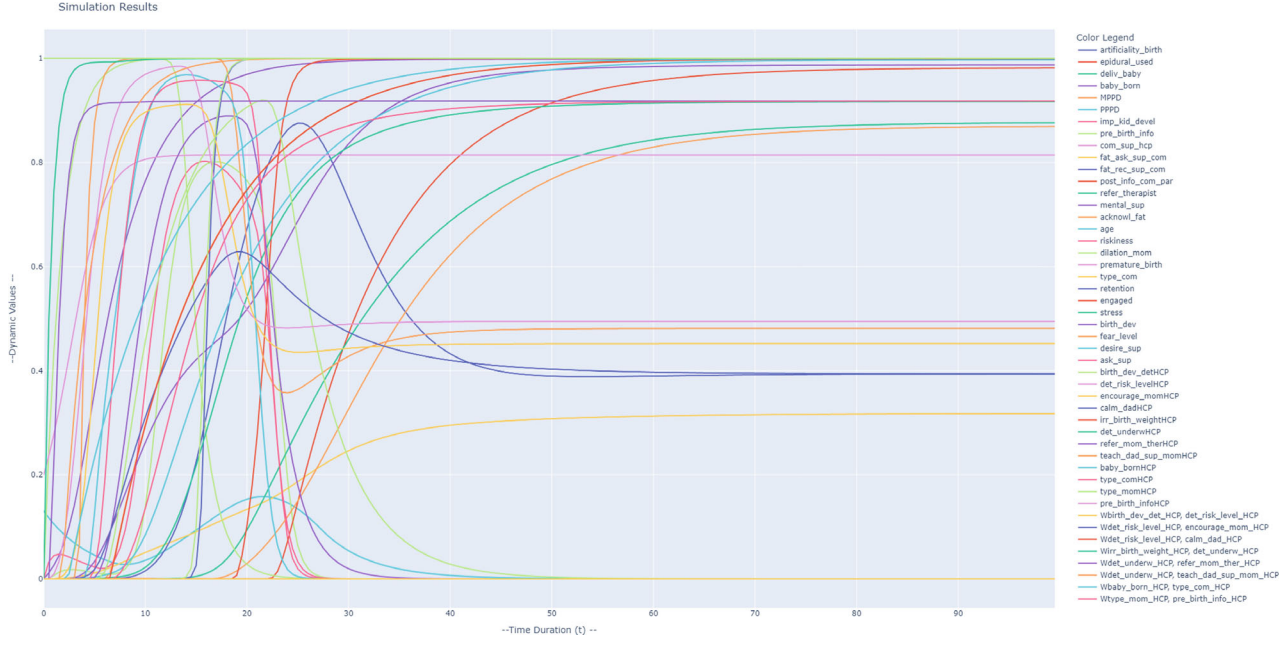
	iv - initial values	1
X_1	type_mom	0
X_2	artificiality_birth	0
X_3	epidural_used	0
X_4	deliv_baby	0
X_5	baby_born	0
X_6	MPPD	0.13
X_7	PPPD	0
X_8	kid_devel	0
X_9	pre_birth_info	0
X_{10}	com_sup_hcp	0
X_{11}	fat_ask_sup_com	0
X_{12}	fat_rec_sup_com	0
X_{13}	post_info_com_par	0
X_{14}	refer_therapist	0
X_{15}	mental_sup	0
X_{16}	acknowl_fat	0
X_{17}	age	1
X_{18}	riskiness	0
X_{19}	dilation_mom	0.2
X_{20}	premature_birth	1
X_{21}	type_com	0
X_{22}	retention	0
X_{23}	engaged	0
X_{24}	stress	0
X_{25}	birth_dev	0
X_{26}	fear_level	0
X_{27}	desire_sup	0
X_{28}	ask_sup	0
X_{29}	$birth\_dev\_det_{HCP}$	0
X_{30}	$det\_risk\_level_{HCP}$	0
X_{31}	$encourage\_mom_{HCP}$	0
X_{32}	$calm\_dad_{HCP}$	0
X_{33}	$irr\_birth\_weight_{HCP}$	0
X_{34}	det_underw_{HCP}	0
X_{35}	$refer\_mom\_ther_{HCP}$	0
X_{36}	$teach\_dad\_sup\_mom_{HCP}$	0
X_{37}	$baby\_born_{HCP}$	0
X_{38}	$type\_com_{HCP}$	0
X_{39}	$type\_mom_{HCP}$	0
X_{40}	$pre\_birth\_info_{HCP}$	0
X_{41}	$birth\_dev\_det_{AIC}$	0
X_{42}	$det\_risk\_level_{AIC}$	0
X_{43}	$encourage\_mom_{AIC}$	0
X_{44}	$calm\_dad_{AIC}$	0
X_{45}	$irr\_birth\_weight_{AIC}$	0
X_{46}	det_underw_{AIC}	0
X_{47}	$refer\_mom\_ther_{AIC}$	0
X_{48}	$teach\_dad\_sup\_mom_{AIC}$	0
X_{49}	$baby\_born_{AIC}$	0
X_{50}	$type\_com_{AIC}$	0
X_{51}	$type\_mom_{AIC}$	0
X_{52}	$pre\_birth\_info_{AIC}$	0
X_{53}	$\mathbf{w}_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	0
X_{54}	$\mathbf{w}_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	0
X_{55}	$\mathbf{w}_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	0
X_{56}	$\mathbf{w}_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	0
X_{57}	$\mathbf{w}_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	0
X_{58}	$\mathbf{w}_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	0
X_{59}	$\mathbf{w}_{baby\_born\_HCP,\ type\_com\_HCP}$	0
X_{60}	$\mathbf{w}_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	0
X_{61}	$\mathbf{w}_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	0
X_{62}	$\mathbf{w}_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	0
X_{63}	$\mathbf{w}_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	0
X_{64}	$\mathbf{w}_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	0
X_{65}	$\mathbf{w}_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	0
X_{66}	$\mathbf{w}_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	0
X_{67}	$\mathbf{w}_{baby\_born\_AIC,\ type\_com\_AIC}$	0
X_{68}	$\mathbf{w}_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	0
X_{69}	$\mathbf{w}_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	0
X_{70}	$\mathbf{w}_{calm\_dad\_AIC,\ acknowl\_fat}$	0
X_{71}	$\mathbf{w}_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	0
X_{72}	$\mathbf{w}_{calm\_dad\_AIC,\ com\_sup\_hcp}$	0
X_{73}	$\mathbf{w}_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	0
X_{74}	$\mathbf{w}_{calm\_dad\_AIC,\ post\_info\_com\_par}$	0
X_{75}	$\mathbf{w}_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	0
X_{76}	$\mathbf{w}_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	0
X_{77}	$\mathbf{w}_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	0
X_{78}	$\mathbf{w}_{calm\_dad\_AIC,\ mental\_sup}$	0
X_{79}	$\mathbf{w}_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	0
X_{80}	$\mathbf{w}_{encourage\_mom\_AIC,\ mental\_sup}$	0
X_{81}	$\mathbf{w}_{refer\_mom\_ther\_AIC,\ mental\_sup}$	0
X_{82}	$\mathbf{w}_{type\_com\_AIC,\ type\_com}$	0
X_{83}	monitor_pre_birth_info	0
X_{84}	$monitor\_acknowl\_fat_1$	0
X_{85}	$monitor\_acknowl\_fat_2$	0
X_{86}	$monitor\_com\_sup\_hcp_1$	0
X_{87}	$monitor\_com\_sup\_hcp_2$	0
X_{88}	$monitor\_post\_info\_com\_par_1$	0
X_{89}	$monitor\_post\_info\_com\_par_2$	0
X_{90}	$monitor\_post\_info\_com\_par_3$	0
X_{91}	monitor_refer_therapist	0
X_{92}	$monitor\_mental\_sup_1$	0
X_{93}	$monitor\_mental\_sup_2$	0
X_{94}	$monitor\_mental\_sup_3$	0
X_{95}	$monitor\_mental\_sup_4$	0
X_{96}	monitor_type_com	0
X_{97}	$\mathbf{w}_{w\_AIC,w\_HCP}$	0
X_{98}	con_feedback	0
X_{99}	$\mathbf{w}_{birth\_dev\_det\_£,\ det\_risk\_level\_£}$	1
X_{100}	$\mathbf{w}_{det\_risk\_level\_£,\ encourage\_mom\_£}$	1
X_{101}	$\mathbf{w}_{det\_risk\_level\_£,\ calm\_dad\_£}$	1
X_{102}	$\mathbf{w}_{irr\_birth\_weight\_£,\ det\_underw\_£}$	1
X_{103}	$\mathbf{w}_{det\_underw\_£,\ refer\_mom\_ther\_£}$	1
X_{104}	$\mathbf{w}_{det\_underw\_£,\ teach\_dad\_sup\_mom\_£}$	1
X_{105}	$\mathbf{w}_{baby\_born\_£,\ type\_com\_£}$	1
X_{106}	$\mathbf{w}_{type\_mom\_£,\ pre\_birth\_info\_£}$	1
X_{107}	$\mathbf{w}_{w\_£,w\_AIC}$	0
X_{108}	con_feedforward	1

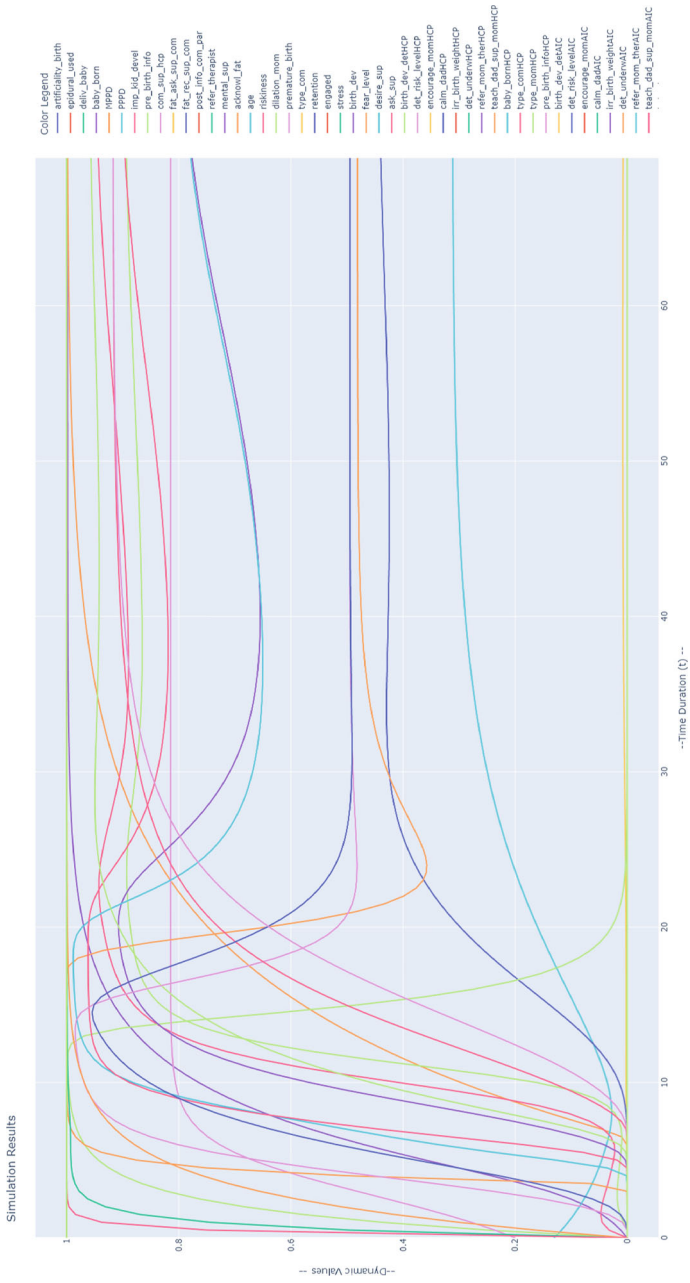
Table 35 Role matrix for Case (d) for **ms**—speed factors

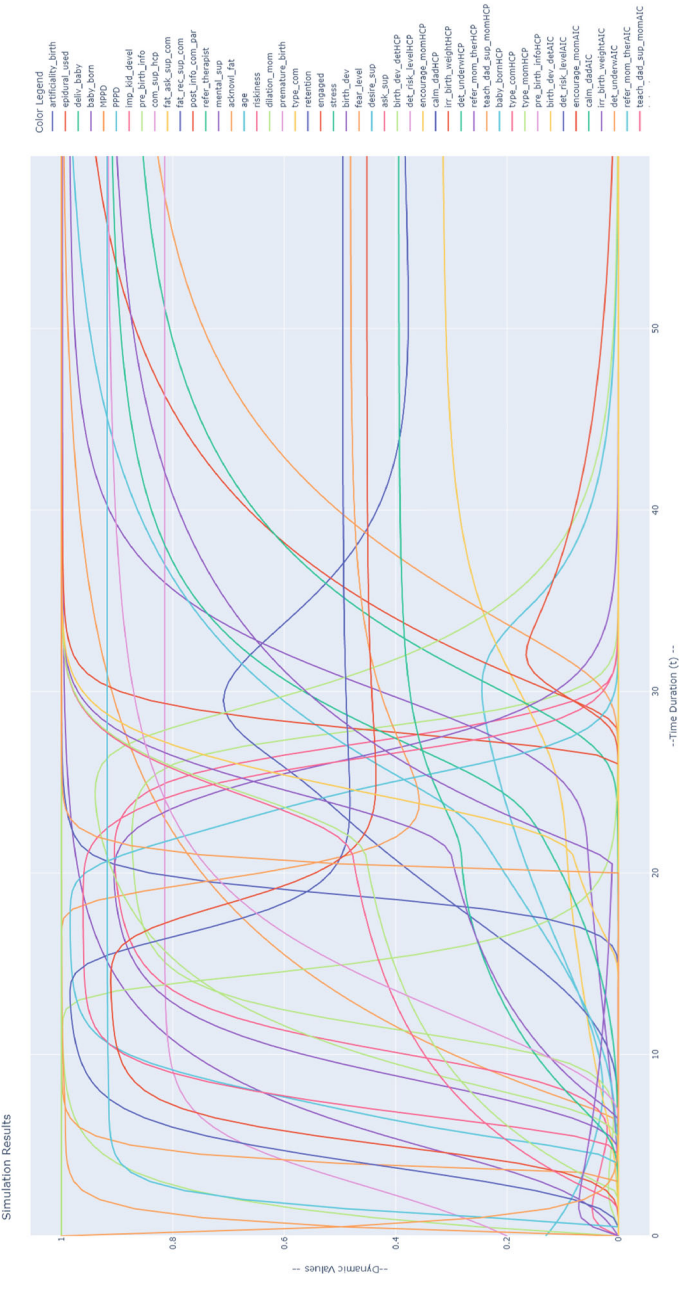
	ms - speed factors	1
x_1	type_mom	1
x_2	artificiality_birth	1
x_3	epidural_used	1
x_4	deliv_baby	0.2
x_5	baby_born	0.1
x_6	MPPD	0.2
x_7	PPPD	1
x_8	kid_devel	1
x_9	pre_birth_info	0.1
x_{10}	com_sup_hcp	0.1
x_{11}	fat_ask_sup_com	0.3
x_{12}	fat_rec_sup_com	0.1
x_{13}	post_info_com_par	0.1
x_{14}	refer_therapist	0.3
x_{15}	mental_sup	0.1
x_{16}	acknowl_fat	0.1
x_{17}	age	0
x_{18}	riskiness	0.5
x_{19}	dilation_mom	1
x_{20}	premature_birth	0
x_{21}	type_com	1
x_{22}	retention	1
x_{23}	engaged	1
x_{24}	stress	0.4
x_{25}	birth_dev	1
x_{26}	fear_level	1
x_{27}	desire_sup	1
x_{28}	ask_sup	0.2
x_{29}	$birth\_dev\_det_{HCP}$	1
x_{30}	$det\_risk\_level_{HCP}$	1
x_{31}	$encourage\_mom_{HCP}$	0.1
x_{32}	$calm\_dad_{HCP}$	0.1
x_{33}	$irr\_birth\_weight_{HCP}$	1
x_{34}	det_underw_{HCP}	1
x_{35}	$refer\_mom\_ther_{HCP}$	0.3
x_{36}	$teach\_dad\_sup\_mom_{HCP}$	0.1
x_{37}	$baby\_born_{HCP}$	1
x_{38}	$type\_com_{HCP}$	1
x_{39}	$type\_mom_{HCP}$	1
x_{40}	$pre\_birth\_info_{HCP}$	1
x_{41}	$birth\_dev\_det_{AIC}$	0.33
x_{42}	$det\_risk\_level_{AIC}$	0.33
x_{43}	$encourage\_mom_{AIC}$	0.033
x_{44}	$calm\_dad_{AIC}$	0.033
x_{45}	$irr\_birth\_weight_{AIC}$	0.33
x_{46}	det_underw_{AIC}	0.33
x_{47}	$refer\_mom\_ther_{AIC}$	0.1
x_{48}	$teach\_dad\_sup\_mom_{AIC}$	0.033
x_{49}	$baby\_born_{AIC}$	0.33
x_{50}	$type\_com_{AIC}$	0.33
x_{51}	$type\_mom_{AIC}$	0.33
x_{52}	$pre\_birth\_info_{AIC}$	0.33
x_{53}	$w_{birth\_dev\_det\_HCP,\ det\_risk\_level\_HCP}$	1
x_{54}	$w_{det\_risk\_level\_HCP,\ encourage\_mom\_HCP}$	1
x_{55}	$w_{det\_risk\_level\_HCP,\ calm\_dad\_HCP}$	1
x_{56}	$w_{irr\_birth\_weight\_HCP,\ det\_underw\_HCP}$	1
x_{57}	$w_{det\_underw\_HCP,\ refer\_mom\_ther\_HCP}$	1
x_{58}	$w_{det\_underw\_HCP,\ teach\_dad\_sup\_mom\_HCP}$	1
x_{59}	$w_{baby\_born\_HCP,\ type\_com\_HCP}$	1
x_{60}	$w_{type\_mom\_HCP,\ pre\_birth\_info\_HCP}$	1
x_{61}	$w_{birth\_dev\_det\_AIC,\ det\_risk\_level\_AIC}$	0.5
x_{62}	$w_{det\_risk\_level\_AIC,\ encourage\_mom\_AIC}$	0.5
x_{63}	$w_{det\_risk\_level\_AIC,\ calm\_dad\_AIC}$	0.5
x_{64}	$w_{irr\_birth\_weight\_AIC,\ det\_underw\_AIC}$	0.5
x_{65}	$w_{det\_underw\_AIC,\ refer\_mom\_ther\_AIC}$	0.5
x_{66}	$w_{det\_underw\_AIC,\ teach\_dad\_sup\_mom\_AIC}$	0.5
x_{67}	$w_{baby\_born\_AIC,\ type\_com\_AIC}$	0.5
x_{68}	$w_{type\_mom\_AIC,\ pre\_birth\_info\_AIC}$	0.5
x_{69}	$w_{pre\_birth\_info\_AIC,\ pre\_birth\_info}$	0.5
x_{70}	$w_{calm\_dad\_AIC,\ acknowl\_fat}$	0.5
x_{71}	$w_{teach\_dad\_sup\_mom\_AIC,\ acknowl\_fat}$	0.5
x_{72}	$w_{calm\_dad\_AIC,\ com\_sup\_hcp}$	0.5
x_{73}	$w_{teach\_dad\_sup\_mom\_AIC,\ com\_sup\_hcp}$	0.5
x_{74}	$w_{calm\_dad\_AIC,\ post\_info\_com\_par}$	0.5
x_{75}	$w_{teach\_dad\_sup\_mom\_AIC,\ post\_info\_com\_par}$	0.5
x_{76}	$w_{encourage\_mom\_AIC,\ post\_info\_com\_par}$	0.5
x_{77}	$w_{refer\_mom\_ther\_AIC,\ refer\_therapist}$	0.5
x_{78}	$w_{calm\_dad\_AIC,\ mental\_sup}$	0.5
x_{79}	$w_{teach\_dad\_sup\_mom\_AIC,\ mental\_sup}$	0.5
x_{80}	$w_{encourage\_mom\_AIC,\ mental\_sup}$	0.5
x_{81}	$w_{refer\_mom\_ther\_AIC,\ mental\_sup}$	0.5
x_{82}	$w_{type\_com\_AIC,\ type\_com}$	0.5
x_{83}	monitor_pre_birth_info	0.5
x_{84}	$monitor\_acknowl\_fat_1$	0.5
x_{85}	$monitor\_acknowl\_fat_2$	0.5
x_{86}	$monitor\_com\_sup\_hcp_1$	0.5
x_{87}	$monitor\_com\_sup\_hcp_2$	0.5
x_{88}	$monitor\_post\_info\_com\_par_1$	0.5
x_{89}	$monitor\_post\_info\_com\_par_2$	0.5
x_{90}	$monitor\_post\_info\_com\_par_3$	0.5
x_{91}	monitor_refer_therapist	0.5
x_{92}	$monitor\_mental\_sup_1$	0.5
x_{93}	$monitor\_mental\_sup_2$	0.5
x_{94}	$monitor\_mental\_sup_3$	0.5
x_{95}	$monitor\_mental\_sup_4$	0.5
x_{96}	monitor_type_com	0.5
x_{97}	w_{w_AIC,w_HCP}	1
x_{98}	con_feedback	0.05
x_{99}	$w_{birth\_dev\_det\_E,\ det\_risk\_level\_E}$	0
x_{100}	$w_{det\_risk\_level\_E,\ encourage\_mom\_E}$	0
x_{101}	$w_{det\_risk\_level\_E,\ calm\_dad\_E}$	0
x_{102}	$w_{irr\_birth\_weight\_E,\ det\_underw\_E}$	0
x_{103}	$w_{det\_underw\_E,\ refer\_mom\_ther\_E}$	0
x_{104}	$w_{det\_underw\_E,\ teach\_dad\_sup\_mom\_E}$	0
x_{105}	$w_{baby\_born\_E,\ type\_com\_E}$	0
x_{106}	$w_{type\_mom\_E,\ pre\_birth\_info\_E}$	0
x_{107}	w_{w_E,w_AIC}	1.5
x_{108}	con_feedforward	0

Communication

Adequate Communication




Ineffective Communication
Simulation Results
Color Legend
artificiality_birth
epidural_used
deliv_baby
baby_born
HPPD
PPPD
mnp_kid_devel
pre_birth_info
comm_dad_sup
fat_ask_sup_com
fat_rec_sup_com
post_info_com_par
refer_therapist
mental_sup
acknowl_fat
age
riskiness
dilation_mom
premature_birth
type_com
education
engaged
stress
birth_dev
fear_level
desire_sup
ask_sup
birth_dev_detHCP
det_risk_levelHCP
encourage_momHCP
calm_dadHCP
im_birth_weightHCP
def_undersHCP
def_momHCP
def_therHCP
teach_dad_sup_momHCP
baby_bornHCP
type_comHCP
type_momHCP
pre_birth_infoHCP
birth_dev_detAIC
det_risk_levelAIC
encourage_momAIC
calm_dadAIC
im_birth_weightAIC
def_undersAIC
def_momAIC
def_therAIC
teach_dad_sup_momAIC
--Dynamic Values --
--Time Duration (t) --
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
60


Simulation Results
Color Legend
artificiality_birth
attach_bad
deliv_baby
baby_bom
HPPD
PPPD
imp_kid_devel
pre_birth_info
com_sup_hcp
fat_ask_sup_com
fat_rec_sup_com
post_info_com_par
refer_mom_therapist
mental_sup
acknowl_fat
age
riskiness
dilation_mom
premature_birth
type_com
retention
engaged
stress
stress_dev
fear_level
desire_sup
ask_sup
birth_dev_detHCP
det_risk_levelHCP
encourage_momHCP
calm_dadHCP
irr_birth_weightHCP
det_underwHCP
refer_mom_therHCP
teach_dad_sup_momHCP
bio_bomHCP
type_comHCP
type_momHCP
pre_birth_infoHCP
birth_dev_detAIC
det_risk_levelAIC
encourage_momAIC
calm_dadAIC
irr_birth_weightAIC
det_underwAIC
refer_mom_therAIC
teach_dad_sup_momAIC
--Dynamic Values --
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
--Time Duration (t) --

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