The Relation Between Timing of Team Membership Change and Transactive Memory Systems

~ Master Thesis ~

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Abstract

For organizations it is of importance that work teams are able to utilize the information and knowledge stock available to them. Group transactive memory systems (TMSs) enable knowledge-worker teams to indeed optimize the value of team members' task-relevant knowledge and thereby increase their effectiveness. However, TMS development may be hampered by changes in work conditions like membership change. These changes in team membership are, in fact, inevitable for teams that exist over time. This thesis examined the relations between timing of membership change and group TMSs and timing of membership change and team performance. More specifically, regarding group TMSs, this research examined the extent to which timing of team membership change affects the accuracy and sharedness of group TMSs.

These relationships were examined by means of an experiment conducted among 81 undergraduate students. During this experiment three-person teams performed a short and complex assembly task. Findings suggest that the timing of membership change does not significantly affect group TMS accuracy and TMS sharedness in ad-hoc, short-lived teams. Moreover, it does not have a significant effect on the quality of team performance in terms of the number of parts missing either. The timing of membership change is, however, found to have an effect on team performance in terms of the time needed to complete the task and the number of mistakes made. The exact relation found between timing of membership change and these two measures of team performance is discussed in this paper.

Two possible explanations for the fact that timing of turnover does not have an effect on the team's TMS development process in terms of the levels of sharedness and accuracy could be the limited length of the task and / or the inappropriateness of solely using subjective measurement scales in studying TMSs. Further, the differences in team performance cannot be attributed to differential levels of TMS accuracy and TMS sharedness. Hence, there must be an alternative explanation for the differences found in this study.

Acknowledgements

"When you come to the end of your rope, tie a knot and hang on"

Franklin D. Roosevelt (1977)

This quote illustrates the writing process of this thesis. Between the day I submitted my thesis proposal and the last day writing this thesis there were quite some instances at which I wondered why I got myself into writing a thesis like this. Yet, I did 'hang on' and, now that I am done, I am proud I made it to the end.

There are some people I would like to thank, who made it possible for me to start this project to begin with and to finish it as well. Firstly, I would like to thank my supervisor, Drs. Bas van Diepen. He encouraged me to indeed study this topic when I approached him with my thesis proposal. Besides, I would not have been able to conduct this research at all if it was not for him giving me the monetary funds needed for the experiment and the pep-talk whenever he saw I got "to the end of my rope". Further, my thanks go out to Sjir Uitdewilligen, whose feedback during the design phase and the actual execution of the experiment was of great help. Finally, I would like to thank all those friends and family members who were so kind to listen to my stories and complaints about this thesis and helped me pull it off.

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1. Introduction

Nowadays organizations are increasingly relying on work groups/teams (LePine, 2003; Moreland & Myaskovsky, 2000; Moreland, 1999), such as project teams, rather than on individuals to perform the work that needs to be done. For organizations it is of importance that the knowledge residing with the team members is used in an effective and efficient manner, enabling teams to accomplish tasks/projects in time and deliver good quality work. In specific, a firm’s learning rate is influenced by its members’ ability to leverage the knowledge accumulated by others, which enables knowledge transfer and an effective division of labour (i.e. coordination of activities) to occur, through a correct understanding of who knows what (Reagans, Argote & Brooks, 2005).

Group transactive memory systems (TMSs) facilitate the development of this understanding, by enabling the encoding, storage, retrieval, and communication of group knowledge. By developing an implicit structure for dividing responsibility for information based on a shared understanding of each team member’s expertise, a TMS increases the quantity and quality of information available to the group (Lewis, Belliveau, Herndon & Keller, 2007), allowing team members to learn, both individually and collectively (Lewis, Lange & Gillis, 2005). Teams that develop a group TMS are more likely to optimize the value of members’ expertise and knowledge, making transactive memory an important point of leverage for organizations (Lewis, 2003; Lewis, 2004; Liang, Moreland & Argote, 1995).

However, team membership may change for a variety of reasons (e.g. turnover, promotions, large organizational restructuring such as downsizing, and transfers) (Eskerod & Blichfeldt, 2005; Parker & Skitmore, 2005; Lewis et al., 2007). In fact, it is argued by several scholars (e.g. Choi & Thompson, 2005; Lewis et al., 2007) that partial turnover is unavoidable in most work groups that exist over time. Parker and Skitmore (2005), for example, find in their study conducted in an international aerospace company that 62% of the project managers in their sample did not manage the project from beginning to end.

Past research reaches different conclusions as to whether membership change has positive or negative effects on teams (Hirst, 2009). On the one hand, researchers point out that membership change may be beneficial to team processes and performance. In specific, newcomers may add to the team’s knowledge stock, induce reconsideration of team processes and strategies and increase creativity (Choi & Thompson, 2005; Lewis et al., 2007, after

Kane, Argote & Levine, 2005). Yet, most studies of the relation between membership change and team TMSs, on the other hand, do not find such positive effects.

Change of team composition may affect a team's TMS (Lewis et al., 2007). Team membership changes may bring challenges related to knowledge transfer along and teams might have to return to some of the earlier stages of their group development process (Eskerod & Blichfeldt, 2005; Arrow, Poole, Henry, Wheelan & Moreland, 2004). Moreover, team membership change may threaten the cognitive structures and processes on which the old team members rely (Moreland & Argote, 2003; Choi & Thompson, 2005). One of the reasons for this being that the distribution of task-relevant knowledge within a group has changed (Moreland, 1999). In addition, previous research suggests that groups who undergo partial membership change suffer from inefficient TMS processes and lower performance (Lewis et al., 2007).

Hirst's (2009) longitudinal study of R&D teams shows that timing of membership change matters; it is significantly related to team performance. Hirst states that membership change is positively related to team performance for newly formed teams, while it is negatively related for long-serving teams. However, no research has been conducted yet (to my knowledge) on the effect of timing of team membership change on TMS development and overall task performance. Hence, the question remains whether and to what extent the development of a group TMS and the performance of project teams, or teams formed to accomplish a certain (ad hoc) task, are differently influenced by the timing of team membership change. Therefore, this research aims to answer the following question:

To what extent does the timing of team membership change affect teams' transactive memory systems (TMSs) in terms of the accuracy and sharedness of team members' beliefs about the distribution of knowledge/skills within the team? And to what extent does timing of team membership change have an effect on team performance*?*

In order to answer this question, the research will need to provide answers to the following sub-questions as well:

a) To what extent are the team members' beliefs about the distribution of knowledge/skills accurate and shared, in an <u>intact group</u>? And, how do these teams perform?

b) ***To what extent are the team member's beliefs about the distribution of knowledge/skills accurate and shared, in teams that experienced team membership change <u>before</u> the <u>midpoint</u> of their existence? And, how do these teams perform?***

c) ***To what extent are the team member's beliefs about the distribution of knowledge/skills accurate and shared, in teams that experienced team membership change <u>after</u> the <u>midpoint</u> of their existence? And, how do these teams perform?***

Answers to these questions will be provided by means of a laboratory experiment. By testing for the effect that timing of membership change has on TMSs and team performance, this thesis provides both researchers and managers with insight on the effect that the timing of reorganization and replacement policies may have on team processes and team performance. Likewise, it will enhance our comprehension of the effect that the timing of membership change might have on a team's ability to utilize members' knowledge and the task-relevant information available to them. Most importantly, this study is an extension to the studies previously conducted on TMSs that have often overlooked the role of temporal issues (e.g. the timing of membership change).

The outline of this thesis is as follows. First, in the next chapter previous research on TMSs and membership change is being discussed. Afterwards, the hypothesized relations will be developed and discussed. Then, what follows is a chapter in which the exact design, procedure and measures of the experiment are being explained. Afterwards, the results of the statistical analyses will be reported. Finally, the implications of these findings are being discussed together with the study's limitations and main conclusions.

2. Transactive Memory Systems and Timing of Team Membership Change

Organizational structures are increasingly team-based and this phenomenon has led to an increase in research conducted on teams too. One of the recent developments in academic research is the application of transactive memory theory to teams. More specifically, there is an increasing interest in finding out how and under what conditions teams develop TMSs and how this may be beneficial to team performance. Next, in this chapter the origins of transactive memory theory are discussed together with the findings of previously conducted research on team membership change in relation to transactive memory. Afterwards, the punctuated-equilibrium model is examined. This model provides the rationale for the chosen points in time at which team membership change took place in the experiment. Together, these studies form the theoretical background of this study. The conceptual model for this thesis, based on the theories that are being discussed here, is presented in Appendix 1. Finally, this chapter concludes with the development and discussion of the study´s hypotheses.

2.1 Transactive Memory Systems

TMS theory is developed by Wegner, Guiliano & Hertel (1985), explaining how couples in a relationship may share a system of cognitive interdependence. Recently, the theory has been applied to groups as well and it is used in studies on group dynamics to, amongst others, enhance our understanding of how knowledge-worker teams can optimize the value of members' knowledge (Lewis, 2003) and increase their effectiveness (Lewis, 2004).

A transactive memory was originally envisioned as a "combination of the individual minds and the communication among them" (Wegner et al., 1985, p.256). The group is conceptualized as having one memory system. More specifically, this team memory system consists of two components: (1) a transactive memory structure, and (2) several transactive processes. First, a *transactive memory structure* is the organizing scheme that connects the knowledge held by each individual to the knowledge held by the others in the system (Wegner et al., 1985; Hollingshead, 2001). In other words, team members that share a transactive memory structure have a shared understanding of who knows what. Based on this understanding teams develop an implicit structure for dividing responsibility between the members (Lewis et al., 2007). Second, the *transactive processes* – encoding, storage, and retrieval processes – enable the transfer of information between different team members. These transactive processes are used to coordinate learning, storage, and retrieval of team members' knowledge, which can then be applied to the task at hand (Lewis et al., 2007). By means of these transactive processes groups coordinate who will be responsible for the encoding and storage of different domains of information and figure out what team members know (i.e. find out each other's expertise), ensuring that together the group possesses all the information needed (Lewis et al.).

Moreover, a characteristic of team TMSs is that they contain more information than the sum of information available in the individual memory systems of the team members (Wegner et al., 1985). This has been confirmed empirically; groups who developed a transactive memory recalled more task relevant information than groups who did not develop a TMS (Moreland & Myaskovsky, 2000). Likewise, previous research points out that teams that develop a TMS are more likely to optimize the value of their members´ expertise and knowledge. Hence, transactive memory is considered to be an important point of leverage for organizations (Lewis, 2003; Lewis, 2004; Liang et al., 1995).

Furthermore, well-developed team TMSs are characterized by high levels of TMS accuracy and TMS sharedness (Austin, 2003). Team TMSs vary, among others, in their accuracy and sharedness (Brandon & Hollingshead, 2004). First, the accuracy of TMSs is the extent to which "group members' perceptions about others' task-related expertise is accurate" (p. 633). Second, TMS sharedness refers to the "degree to which members have a shared representation of the transactive memory system" (p.633). The higher the accuracy and sharedness of the group's mental models, the more effective the TMS, and thus the team, will be.

2.2 Membership Change and Transactive Memory

Previous research suggests that shared experiences among group members (e.g. attending a training session together) allow groups to develop TMSs (Lewis, 2003; Moreland & Myaskovsky, 2000; Liang et al., 1995). However, work groups are subject to membership change (i.e. are dynamic). Membership change is argued to be inevitable in teams that exist over time (e.g. Choi & Thompson, 2005; Lewis et al., 2007) and may occur, for instance, in situations of promotions, transfers and larger reorganizations such as downsizing. Therefore, the process of developing a TMS might be disrupted by changes in team membership. Most of the studies on small groups, nonetheless, treat groups as closed systems (i.e. do not consider what happens as new members join a group and/or existing members leave the group) (Choi & Thompson, 2005; McGrath, Arrow & Berdahl, 2000).

There do exist, however, several studies that do acknowledge that group membership is subject to change. These studies look at the impact that membership change/turnover might have on group cognition and performance and argue that turnover changes the distribution of task-relevant knowledge available to the group and will, therefore, disrupt group TMSs. First, Lewis et al. (2007), for example, point out that partial group membership change leads to TMS process inefficiencies and inferior performance relative to work groups who have a stable membership. In other words, partial group membership change inhibits teams to reap the full benefits of group-level knowledge. This can partly be explained by the fact that membership changes threaten the cognitive structures and processes on which the old team members rely (Moreland & Argote, 2003; Choi & Thompson, 2005) and alter the distribution of task-relevant knowledge in the team (Moreland, 1999). Second, Moreland states that reassigning team members after training disabled group TMSs and harmed group performance.

These two studies solely considered the effect of group membership changes that took place right after the group-training sessions of the laboratory experiment (i.e. they simply looked at membership changes at one specific point in time). However, group membership change may vary along several dimensions, one of which is the timing of change. Choi & Thompson (2005) argue that the timing of membership change is likely to affect group functioning, and that this issue should be addressed by future research. They argue that the impact of membership change depends on, amongst others, when it occurs and whether it is expected by team members or not. Therefore, the relationships between timing of team membership change and group TMS development (i.e. the sharedness and accuracy of team members' beliefs on the distribution of knowledge/skills within the team) and team performance are examined in this thesis.

2.3 The Punctuated-Equilibrium Model

The study's sub-questions (see previous chapter) refer to teams that experienced membership change before and after their 'midpoint'. This decision to take team membership change before and after the midpoint of the team's existence to represent 'timing of team membership change' in this study is based on the punctuated-equilibrium model. This model is a theory on the stages of group development which applies to groups formed to perform a temporary task within a specific time period (Gersick, 1988; Robbins & Judge, 2007). Figure 1 shows what the punctuated-equilibrium model looks like.

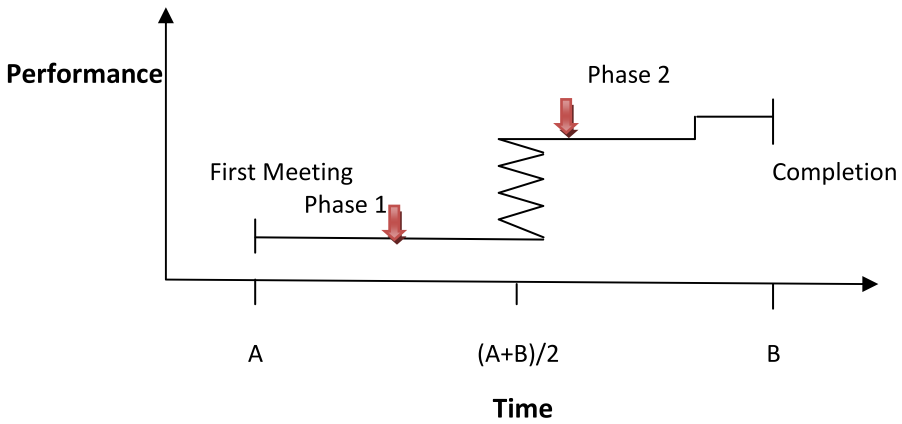

Figure 1: The Punctuated-Equilibrium Model
(Adopted from Robbins & Judge, 2007, p. 304)

In short, the punctuated-equilibrium model postulates that during the team members' first meeting a group sets its direction, and behaviour patterns and assumptions of how to approach the task come into existence. This direction is unlikely to be questioned during the first half of the group's existence (i.e. Phase 1). Phase 1 is characterized as a period of inertia; even if the group develops new insights that challenge their behavioural patterns and assumptions, the group is not able to act upon these insights. However, around the midpoint of the group's life, the group experiences a transition during which team members become aware that time is limited and adjust their patterns, assumptions and perspectives. After this transition period groups enter another period of inertia (i.e. Phase 2), in which they act upon their new direction and perspectives gained during the transition period (Robbins & Judge, 2007).

The punctuated-equilibrium model is relevant to this study since it might suggest that teams that face partial team membership change during their 'Phase 1' might still use the insights, expertise and information of the newcomer to develop their new direction and perspectives during the transition period, after which they will start performing. The oldtimers will be able to adjust their TMS structure so as to integrate and utilize the newcomer's knowledge. Teams that go through partial team membership change during 'Phase 2', on the other hand, might not be able to use the information and expertise of the newcomer since ‘Phase 2’ is characterized by a group’s incapability to act upon new insights. The oldtimers in the group are expected to stick to their TMS structure and, hence, the group may find it difficult to adjust their operations in accordance to the changes in the distribution of information and expertise caused by the team membership change.

Next, now that the theoretical background of this thesis has been discussed, the discussion turns to the development of the hypothesized relationships between timing of membership change, TMSs and team performance.

2.4 Hypotheses

One major shortcoming of the current state of the research on group TMSs is the lack of studies conducted on the precise development of TMSs in groups; how TMSs evolve during the different phases of performing a complex task (Lewis, 2004). Therefore, it is a challenging job to develop hypotheses on how (1) accuracy and (2) sharedness of team members’ beliefs about the distribution of knowledge and skills within the team, and (3) group performance will be affected by the group membership change at different points in time. However, based on previous research and the punctuated-equilibrium model, several hypotheses were developed for this study. These hypotheses are being discussed below.

2.4.1 The Relationship between Timing of Turnover and TMS Accuracy

TMS accuracy is defined as the extent to which individual members identified by others in the team as having particular knowledge and skills actually do posses this knowledge and skill (Austin, 2003). The timing of team membership change is expected to affect TMS accuracy.

Teams that do not face team membership change will be able to develop a team TMS over time and rely on and refine their TMS (e.g. by means of the transactive processes) during their task performance. Therefore, teams who remain intact are expected to have the most accurate view on the distribution of knowledge within the team.

H1$_{a}$: *Intact teams will have more accurate views, at the end of their task performance, on the distribution of knowledge within the team than teams that faced partial team membership change.*

Further, teams that face partial membership change early in their lifetime (i.e. during 'Phase 1') will be able to interact and refine their TMS during the transition phase, in which they can redefine their direction and assumptions made earlier. However, the oldtimers of the team may have developed a TMS on which they relied for some time already and can be expected to be a little hesitant to refining their TMS. Hence, one would expect the team members' views on the distribution of knowledge within the team to be less accurate than in an intact team.

H1$_b$: *Teams that faced partial membership change before the midpoint of their existence will, at the end of their task performance, have less accurate views on the distribution of knowledge within the team than intact teams, but more accurate than teams that faced partial membership change after the midpoint of their lifetime.*

Teams members of teams that face partial membership change later in their lifetime (i.e. during 'Phase 2') have less time to interact and refine their TMS and, in addition, when they are in this phase they are anticipated to be in a period of inertia. During this period teams are expected to be unable to act upon possible new insight gained. In other words, the team is expected to be unable to refine the groups' TMS by taking into account the newcomer's knowledge and skills. Therefore, one would predict the team members' views on the distribution of knowledge within the team to be least accurate.

H1$_c$: *Teams that faced partial membership change after the midpoint of their existence will have the least accurate views, at the end of their task performance, on the distribution of knowledge within the team compared to teams that remained intact or faced partial team membership change before the midpoint of their lifetime.*

2.4.2 The Relationship between Timing of Turnover and TMS Sharedness

Next to accuracy, sharedness is another important component of transactive memory that has been shown to affect team processes and performance (Austin, 2003). Hinsz et al. (1997, as cited in Brandon & Hollingshead, 2004) found that every group produces forces that direct the group toward shared mental models. Therefore, new groups and groups that have gone through membership change will both tend toward developing shared representations of who knows what in the team, and variation among the these perceptions of individual team members should thus decrease over time. However, differences between intact teams and teams that experience membership change are anticipated to exist in terms of their team TMS sharedness.

In particular, teams that do not face team membership change (i.e. are both trained in the task and perform the task in the same composition) will be able to develop a team TMS during the training session and rely on and refine their TMS during the task performance. Moreover, the members of these groups will have more time to adjust their individual mental models and develop shared mental models, than members of teams that did face membership change. Therefore, intact groups are expected to have the most shared representation of the distribution of knowledge within the team, agreeing on who has what knowledge.

H2$_a$: *At the end of their task performance, team members of intact teams will have a more shared view on the distribution of knowledge within the team than the team members of teams that faced partial team membership change.*

Further, team members of teams that faced membership change before the midpoint of the team's existence will be able to adjust their individual mental models to the new situation (i.e. the change in knowledge and skill distribution in the team due to membership change) since they will still go through their 'transition phase', in which they are open to new information. Therefore, even though the development of a shared mental model on the distribution of knowledge and skills within the group will be more difficult for teams that face partial membership change early in their lifetime (i.e. during 'Phase 1') than for intact groups, it will be less difficult than for teams that go through membership change after the team's midpoint. This because the members of teams that face membership change during 'Phase 2' will not be receptive to changes in conditions and tend to continue operations based on the direction set out during the 'transition phase'.

H2$_b$: *At the end of their task performance, team members of teams that faced partial membership change before the midpoint of their existence will have a less shared view on the distribution of knowledge within the team than the team members of intact teams, but more shared than the team members of teams that faced partial membership change after the midpoint of their lifetime.*

Moreover, the team members of teams that faced team membership change late in their lifetime simply have less time to adjust their mental models and refine their team TMS in accordance with the changed situation/team composition.

H2$_c$: *Teams that faced partial membership change after the midpoint of their existence will have the least shared view on the distribution of knowledge within the team, compared to the team members of teams that faced partial membership change before the midpoint of their existence and teams that remained intact.*

2.4.3 The Relationship between Timing of Turnover and Team Performance

Since the development of a TMS is associated with better (i.e. quicker and more accurate) team performance and the effectiveness of a TMS is dependent on the levels of accuracy and sharedness of the team's transactive memory structure (Austin, 2003; Brandon & Hollingshead, 2004), expectations are that intact teams will outperform teams that faced partial membership change during 'Phase 1', which will in turn outperform teams that faced team membership change during 'Phase 2'. Hence, the following hypotheses with respect to team performance were developed:

H3$_a$: *Intact teams will take the i) least time to complete their task. Moreover, they make ii) fewer mistakes and have iii) fewer parts missing than teams that face partial team membership change.*

H3$_b$: *Teams that faced partial membership change before the midpoint of their existence will take i) more time than intact groups to perform the task, but less time than teams that faced membership change after the midpoint. Moreover, they will make ii) more mistakes and have iii) more parts missing than teams intact teams, but less than teams that faced membership change after the midpoint.*

H3$_c$: *Teams that faced partial team membership change after the midpoint of their existence will need the iii) most time to complete their task and will make the ii) most mistakes and have the iii) most missing parts, compared to teams that stayed intact or faced partial team membership change before the midpoint of their existence.*

2.4.4 TMS Sharedness and TMS Accuracy as Mediating Variables in the Relationship between Timing of Turnover and Team Performance

The suggested relationship between timing of membership change and team performance is expected to be mediated by the sharedness and accuracy of the team's TMS. That is to say, it is anticipated that the higher the team's TMS accuracy and TMS sharedness scores, the better the team performs in terms of time taken, and the number mistakes made and missing parts;

$H4_a$: *The relationship between timing of turnover and team performance will be mediated by the accuracy a team's TMS.*

$H4_b$: *The relationship between timing of turnover and team performance will be mediated by the sharedness of a team's TMS.*

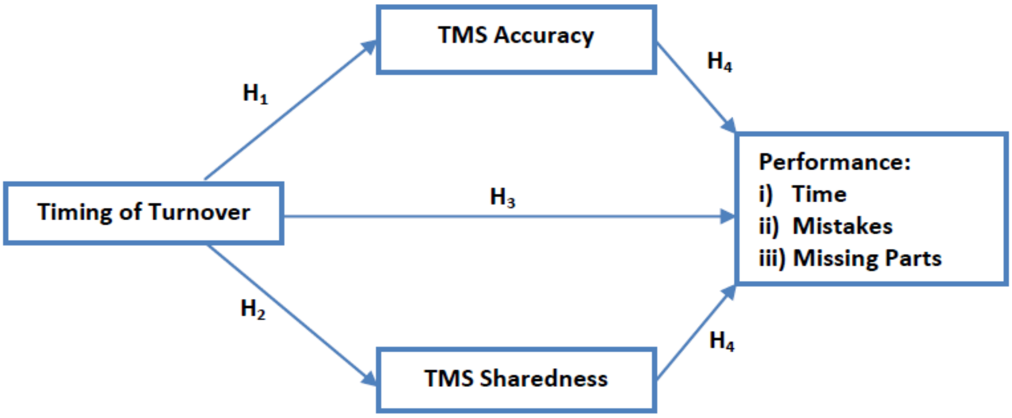

Figure 2: Hypotheses

Figure 2 provides an overview of the developed hypotheses. In the following chapter the exact design, procedure and measures of the experiment that has been conducted in order to test for these hypotheses are being discussed.

3. Methodology

The purpose of this study is to investigate the effect that the timing of team membership change has on group TMSs and overall team performance. To accomplish this, a formal study with precise procedures and data source specifications is required. The (primary) data necessary to answer the research question were collected by means of conducting an experiment and having the participants fill out several questionnaires during the experiment. An experiment was conducted since an experimental design is the primary scientific method to establish causation (Bloomberg, Cooper & Schindler, 2005) and allows for the manipulation of the variable of interest, the independent variable: timing of team membership change. Moreover, an experimental design was chosen since previous studies on TMSs have often made use of laboratory research and experimental designs as well (e.g. Lewis et al., 2005; Lewis et al., 2007; Rulke & Rau, 2000; Moreland, 1999; Moreland & Myaskovsky, 2002; Hollingshead, 2001).

This chapter discusses the details of the experiment and measurement of the data. First, some details are provided about the participants of the experiment. Then, the chapter continues with the provision of an outline of the experiment's design and a discussion of the pre-tests ran. Thereafter, the precise procedure of the actual experimental sessions is being described. Finally, the chapter concludes with a discussion delineating the variables of interest to this research on how these were measured.

3.1 Participants

Participants in the experiment were 81 self-selecting undergraduate students of Maastricht University who were rewarded for their participation. Participation in the experiment was voluntary and students were informed, by means of an information letter (see Appendix 2), that they could withdraw from the experiment at any point in time. The reward for participation was €10 for each participant. In addition, the best performing team received a reward of €60 for their participation (€20 for each team member). The reason for making the reward contingent on team performance is that reward interdependence induces team effort and coordination (Wageman, 1995), stimulating TMS development.

Three participants had to be withdrawn from the sample, however, since their team could not be subjected to the treatment they were initially assigned to. Therefore, the final number of participants was 78. The age of these participants ranged between 19 and 28 years (mean = 22.04, S.D. = 2.05) and 47 (60.3%) were female and 31 (39.7%) were male. 72 (92.2%) of the participants were enrolled at the School of Business and Economics and 6 (7.7%) students were studying at another faculty of Maastricht University. The participants came from a wide variety of nations; 21 participants (26.9%) were Dutch, 21 (26.9%) were German, and 36 (46.2%) students had another nationality (e.g. Chinese, Singaporean, Taiwanese, Bulgarian, Colombian, Turkish, etc).

The participants were assigned to three-person teams. Hence, there were 26 (i.e. 78/3) teams that participated in the experiment; 4 in the control condition, 12 in the early turnover condition and 10 teams in the late turnover condition. The participants registered themselves for a particular time slot of the experiment but did not know that the sessions would differ in terms of the treatment given to participants (i.e. control group, early turnover, or late turnover). In specific, participants were not informed that some of the team members might be reassigned to a different group after the training session, since those who expect turnover may decide not to rely on transactive memory (Lewis et al., 2005). Instead, participants were only informed about the fact that they would be performing a certain task in small teams and that the study was designed to investigate certain team processes.

3.2 Design

During the experiment teams were asked to complete a certain complex task within a certain timeframe. This setting provides the closest possible resemblance of an (ad-hoc) project team. The complex task included the assembly of a telephone kit (AmeriKit, model AK-750, sciencekits.com), which has been used in previous studies on group TMSs too (e.g. Lewis et al., 2007; Lewis, 2003; Moreland, 1999; Moreland & Myaskovsky, 2000). For this task team members need to use a wide variety of physical and cognitive skills, making TMSs relevant to the task performance. In particular, Lewis et al. (2007) state that TMSs are relevant to this assembly task since it (1) requires division of labour and interdependent actions of all members to complete successfully, and (2) is sufficiently complex in terms of the possibility to make mistakes.

The experiment had a between-groups design, where separate groups of participants are used for each of the conditions in the experiment. More specifically, it was a post-test only/control group design (Field & Hole, 2003), with a control group and two types of groups receiving different treatment levels (i.e. early turnover and late turnover).

The objective of the task was to complete the telephone assembly as quickly and as accurately as possible. The experiment consisted of a training phase, a practicing phase and a performance phase. Before and after the performance phase questionnaires had to be filled out by the participants. During the training phase teams received a training of approximately 20 minutes. This training consisted of a PowerPoint presentation showing the ten steps of the assembly (see Appendix 3), a voice-over describing the steps and the experimenter performing the actual telephone assembly after each respective step was shown on the slides. A training phase was part of the experiment since having members trained together induces the development of TMSs (Lewis, 2003, Moreland & Myaskovsky, 2000; Liang et al., 1995).

After the training, teams were given 20 minutes to practice the task as a team. During this practice period teams had the possibility to ask the experimenter two questions each. After the practice phase, teams were given 15 minutes to perform the telephone assembly task. However, teams in the early turnover condition had one team member replaced after 5 minutes into their performance time and teams in the late turnover condition had one team member replaced after 10 minutes. How and why these exact times of the deadline and team membership changes were chosen follows from the subsequent discussion of this study's pre-tests.

3.2.1 Pre-tests

Pre-tests are being conducted to detect weaknesses in the design and instrumentation of the experiment. Results of these pre-tests are typically used to refine questionnaires, instruments and procedures (Bloomberg et al., 2005). The purpose for running pre-tests for this study was twofold. First, by conducting pre-tests it was checked whether the training and questionnaire items were clear to the participants. Second, the tests gave an idea of how much time teams actually need to perform the assembly task. The risk of giving teams too much time to complete the task would be that if teams could perform the task way within the time allocated it would be impossible to determine what would be the precise 'midpoint' of the teams' existence. This midpoint would be different for teams finishing, for example, after 20 minutes and those finishing after 30 minutes. Consequently, without a reliable 'midpoint' it would not be possible to decide when the experimental manipulations of turnover in ‘Phase 1’ and ‘Phase 2’ should take place. Moreover, by giving teams a tight deadline rather than too much time, members are required to tacitly coordinate their actions and avoid using precious time to plan. This need for tacit planning, in turn, increases the potential relevance for TMSs in this task (Wittenbaum, Vaughan & Stasser, 1998).

The first pre-test was done with three students; studying at University College Maastricht and the European Law School of Maastricht University. This pre-test led to several adjustments in the design of the experiment. First, it appeared that giving the participants cards with visuals showing the separate steps made the task too simple to accomplish (i.e. the team put all the parts belonging to the steps next to the cards and then started to perform the task). Moreover, it became clear that the timeframe of 30 minutes was too broad, since the team managed to perform the task much faster. In addition, performing all the steps during the training phase took longer than anticipated and based on the feedback of the students it became clear that this was perceived as a negative aspect of the training phase that had to be resolved.

Based on the findings of this first pre-test it was decided that the teams would not be given the cards with each step depicted on it and that the timeframe of the performance phase had to be reduced from 30 to 15 minutes. In addition, the issue regarding the training was resolved by preparing some of the steps of the assembly task before the training phase. This way, the training would not take as much time as before (i.e. the experimenter would not have to perform each step in front of the participants) and teams would still be able to observe the different steps and see what the parts would look like after performing each respective step.

A second pre-test was done with three students from the School of Business and Economics in one of the rooms that was also used for running the actual experiment. Apart from the adjustments made to the design of the experiment, this pre-test also tested the exact experimental setting. The adjustments made to the design proved to be actual improvements. This time the students managed to perform the task just within the 15-minute time limit. This gave enough assurance that the performance phase could indeed be set 15 minutes and that the treatments could take place after 5 and 10 minutes respectively (i.e. well before and after the 7.5 minute ‘midpoint’). After this second pre-test some final minor adjustments were made to the experiment’s protocol. The final protocol can be found in Appendix 4.

3.3 Experiment

The experiment was conducted over a period of three-and-a-halve weeks. Each session of the experiment lasted 1.5 hours approximately. The setting of the rooms in which the experiment took place was exactly the same for each session (see Figure 3 for the set-up at the beginning of the experiment; see Appendix 4 for precise settings later in the experiment).

The windows of the room were covered with paper so none could see what was happening inside and/or distract the participants by walking passed the room. Further, a beamer with a screen at which the participants could see the PowerPoint presentation during the training phase was located behind the chair of the experimenter. Moreover, in front of the experimenter the 10 steps of the assembly task were lined out. The parts were covered with paper so none could have a look at them before the training actually started. Furthermore, there were six numbered chairs in the room: chair 1, 2 and 3 at one side of the table, and chairs 4, 5 and 6 at the other side of the table. Two movable walls functioned as a shield between the two ends of the table so teams could not see or communicate with each other when performing the task. There were two cameras in the room, which were used to record the teams' performance during the performance phase. Finally, the unassembled telephones that were used for the experiment were packed in plastic boxes together with a Philips-screwdriver and a 9-volts battery. Each box contained all the materials the team needed to perform the task.

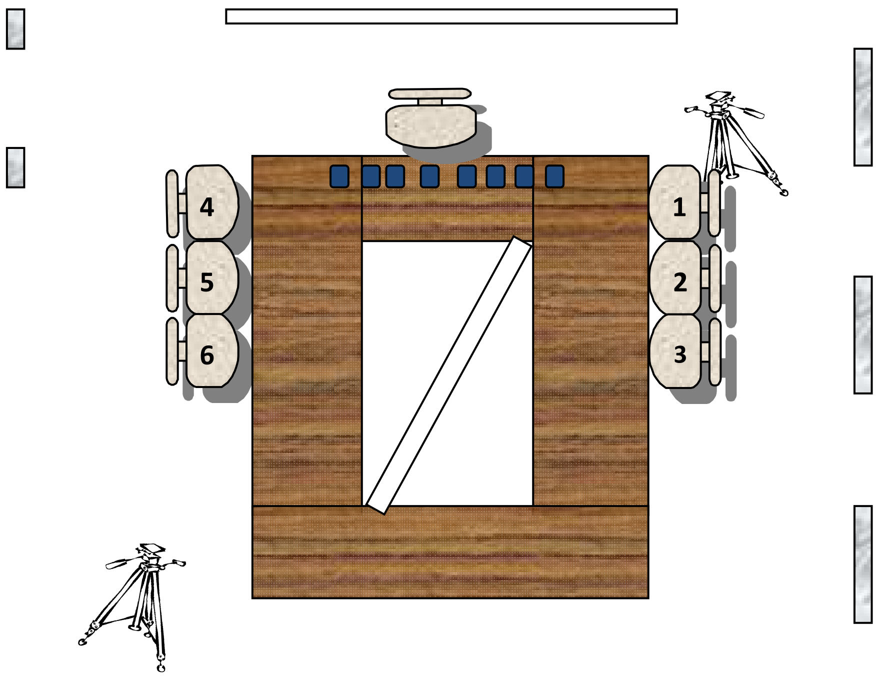

Figure 3: Set-up of the experiment (starting position)

By designing and making use of a strict protocol it was ensured that all teams were given exactly the same information and treatment in each experimental session. Moreover, all sessions took place at the same time of the day (i.e. an a.m. and a p.m. session), so the timing of the session could not be of influence on the data collection. Before the experiment started and participants were allowed into the room, the participants' names were checked at the door. Hereafter, participants were asked to switch off their cell phone and to draw one of the numbered cards from the stack the experimenter held in her hands. These cards were numbered 1 to 6 and corresponded to the numbers of the chairs in the room. (See Figure 4 for the timeline of the experimental sessions)

After everyone had taken a card, participants were asked to enter the room and to take the seat corresponding to their number. Here the participants found an information letter and a numbered sticker. Participants were asked to sign the informed consent form at the bottom of the information letter and to put the numbered sticker on their clothing, somewhere visible to the experimenter. Person 1, 2 and 3 sat next to each other and formed a team and Person 4, 5, 6 formed a team as well.

As soon as everyone had signed the information letter, the experiment started with an introduction on the content of the experiment, after which the training started. During this training the participants were not allowed to ask any questions, talk to each other, or to write down notes. After the training was over, each team was given a box with the unassembled telephone and 20 minutes were allocated to practice the task. Before teams were allowed to open the box and start practicing the assembly, they were told that it was best to divide the task within their team. This information was given in order to stimulate the division of labour, so that team members specialize in a certain aspect of the task which enables the team to develop a TMS.

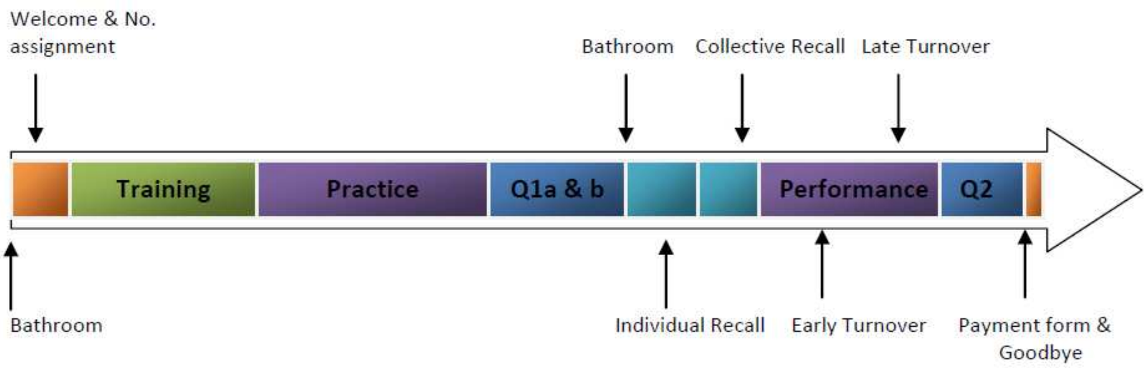

Figure 4: Timeline experimental session

During the practice phase each team was allowed to ask two questions. In case teams had a question, they raised their hand and the experimenter came over to their table to answer the question in private. No communication between the teams and no note taking was allowed. After the practice phase was over, participants were asked to go and sit like is depicted in Figure 5.

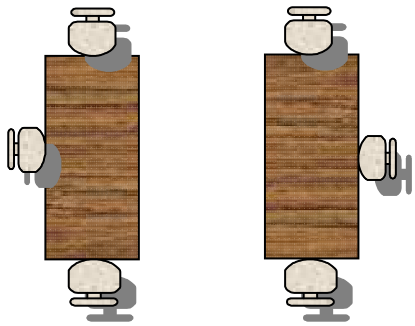

Figure 5: 'Questionnaire positions' participants

Next, participants were handed Questionnaire 1a and Questionnaire 1b together with a plasticized card describing the skills/knowledge areas that were defined for the telephone assembly task (for details see Appendices 5, 6 and 7). Participants were asked to fill in the questionnaires rapidly but accurately. The positioning of the participants ensured that they could not see what their team members filled in. This was necessary to prevent bias in the answers relating to each team member’s expertise. The questions of Questionnaires 1a and 1b were the same for all participants and all three treatment conditions. The questions only differed in the particular team members they referred to (i.e. Questionnaire 1a asks person 1 about person 2 and 3, while person 2 is asked about team members 1 and 3).

After filling in the questionnaires, participants were asked to try and recall as many of the steps of the telephone assembly as possible. The task consisted of 10 steps which required 34 separate actions. Participants were given 7 minutes to note down whatever they recalled on the individual recall sheet (see Appendix 8). Once these 7 minutes were over each team was asked to go and sit back together again. Now participants were given 7 minutes to try and recall as many of the steps of the assembly as possible as a team. For this task each team was handed a collective recall sheet which looked similar to the individual recall sheet. After the 7 minutes had past, the experiment continued with the next phase, namely the performance phase

During this phase each team was handed a new box with an unassembled telephone kit. Before teams were allowed to open the box they were again informed that no communication between the teams was allowed and that their team performance was evaluated based on the time till completion, the number of missing parts and the number of mistakes made. Moreover, participants were once more reminded that dividing the task between the team members might be the best strategy to accomplish the task. This time teams were given 15 minutes to accomplish the task.

Each team was videotaped during the performance phase. Teams in the control condition did not face any alterations in their team composition. That is to say, these teams consisted of the same team members from the beginning till the end of the experiment. However, teams in the early turnover and late turnover condition were subjected to a change in their composition. Respectively, these teams experienced team membership change in ‘Phase 1’ (i.e. after 5 minutes) or ‘Phase 2’ (i.e. after 10 minutes) of the team’s existence. To accomplish this change person 2 and 5 were asked to let go of the work they were performing and to take a seat at the other team’s table and to continue working on the task.

After the performance phase, the participants had to fill in one final questionnaire; Questionnaire 2 (see Appendix 9). Questionnaire 2 was the same for all participants in terms of the questions asked. However, the answers they could give were adjusted in accordance to the team members the participant had worked with during the experiment. That is to say, in the treatment conditions Person 2 was asked questions that referred to Person 1, 3, 4 and 6, while in the control condition Person 2 was asked the same questions but these referred to Person 1 and 3 only. Once all the sessions of the experiment were ran, participants were debriefed by means of an e-mail telling them what the experiment was about and that they, if interested, could receive a digital version of this thesis.

In the next sections it will be explained how running this experiment and having the participants fill in the questionnaires exactly contributed to the collection and measurement of the data necessary for this study

3.4 Measures

Several measures were used to collect all the data for this thesis. As already mentioned in the previous sections, in addition to measuring team performance, the data for this study were collected by means of having the participants fill out several questionnaires and recall sheets.

These measures are being discussed here. The discussion starts with the provision of an overview of the variables of interest to this study. Then, this section continues with an explanation of how these independent variable and dependent variables were operationalized and measured. Finally, the chapter concludes with a discussion of how and why additional variables were measured. These additional variables measured characteristics of the task and teams, whose effect on the dependent variable(s), if any, this research would like to control for.

An overview of the independent variable (IV), dependent variables (DVs) and mediating variables (MVs) of interest to the hypotheses is shown in Table 1. Next, we come to the question of how each of these variables, and other variables that might have an effect on the DVs were operationalized / measured.

Hypothesis	IV	DV	MV
H_1	Timing of Turnover	TMS Accuracy	X
H_2	Timing of Turnover	TMS Sharedness	X
H_3	Timing of Turnover	Team performance i) Time till completion ii) No. of Mistakes iii) No. of Missing Parts	X
H_4	Timing of Turnover	Team performance i) Time till completion ii) No. of Mistakes iii) No. Missing parts	TMS accuracy & TMS sharedness

Table 1: Variables of Interest for each Hypothesis

3.4.1 Timing of Turnover

For this experiment, ‘team membership change’ means that, during the task performance phase, one of the three team members of the team will be replaced by another person, who was till then a member of the other team in that session. More specifically, team membership change was administered by means of making Person 2 and Person 5 of the respective experimental session switch teams.

As mentioned in the discussion of the experimental design already, timing of team membership change consisted of two treatment levels; (1) during ‘Phase 1’ or (2) during ‘Phase 2’. First, team membership changes during ‘Phase 1’ were made after 5 minutes, since this was well before the midpoint (i.e. 7.5 minutes into the performance phase). Teams receiving this treatment belonged to the ‘early turnover’ condition. Second, turnover in ‘Phase 2’ was executed after 10 minutes, since this was well after the midpoint of the team’s existence. Teams receiving this second type of treatment belonged to the ‘late turnover’ condition.

3.4.2 Dependent Variables

In this section it is being discussed how each of the DVs was measured in this study (i.e. the questionnaire items, the measurement level, etc.)

3.4.2.1 TMS Accuracy

Accuracy of team members’ views on the distribution of knowledge and skill within the team is defined as the “degree to which group members’ perceptions about others’ task related expertise are accurate” (Brandon & Hollingshead, 2004, p. 633). Brandon and Hollingshead note that accuracy might be difficult to measure since an objective measure of true expertise may not be available. Therefore, they suggest that one could make use of a subjective measure for both individual group members and the group. In this case, one would measure the view the group holds on the distribution of knowledge, by asking team members, for example, to what extent they feel that their individual mental models about expertise are accurate. This current research used a similar subjective measure, which is developed by Austin (2003).

Austin (2003) developed a questionnaire that enables the calculation of group transactive memory accuracy (see Appendix 10), by making use of team members’ self- and other-reports of expertise. Accuracy is then determined by combining the group members’ ratings of an individual’s expertise and his/her self-report ratings of expertise. Accuracy in a group is high when the group members’ ratings correspond with group members’ self-ratings.

For this study an adjusted version of Austin’s questionnaire was used to test for team TMS accuracy. Each participant had to fill out several items on the questionnaires that referred to the participant’s and his/her team members’ expertise (i.e. Questions 9 and 10 on Questionnaire 1a and Questions 14 and 15 on Questionnaire 2; see Appendices 5 and 9). These questions referred to the different specializations possible for the telephone assembly task; (1) mechanical knowledge, (2) handset assembly, (3) cradle assembly, (4) screw driving, (5) organizing / sorting parts, (6) keypad assembly and (7) small parts assembly (Lewis et al., 2007). The team members’ answers to these particular questions were used to calculate the

TMS accuracy score for each team. This score ranged from 1 to 5. The higher the score, the more accurate the team members' perceptions of who know what. The exact formulas used for this calculation are found in Appendix 10.

Since both Questionnaire 1a and Questionnaire 2 contain questions referring to these specializations, there were two occasions at which TMS accuracy was measured; after the practice phase and after the performance phase. The latter measurement of *TMS accuracy* was the one used as the DV of this study. The measurement of transactive memory accuracy after the practice phase was done so that it could be controlled for if related to the DV.

3.4.2.2 TMS Sharedness

"Sharedness" of team members' views on the distribution of knowledge and skill within the team, also known as transactive memory consensus (Austin, 2003), is defined as "the degree to which members have a shared representation of the transactive memory system" (Brandon & Hollingshead, 2004, p. 633). This variable can be measured at the group-level as well. By comparing the mental models of the group members and calculating the level of variation one can measure group-level sharedness (Brandon & Hollingshead).

Austin developed an example questionnaire which can be used to calculate the group consensus; the degree to which group members agree about who has what knowledge TMS sharedness / consensus is high when group members identify the same individuals as an expert on a given skill. Afterwards, the different consensus scores for each skill were combined in order to calculate the mean TMS sharedness for each group (for details on the calculation see Appendix 10 and Austin, 2003, p.870).

In order test for TMS sharedness, Austin's example questionnaire was adjusted to the context of this experiment. The answers of the individual participant were aggregated to a team-score. This team-score for *TMS sharedness* is in fact a percentage score, ranging from 0 to 1. The higher the score, the more shared team members' perceptions of who has what knowledge. TMS sharedness was measured at two occasions, like TMS accuracy; after the practice phase and after the performance phase. The latter measurement of TMS sharedness was the one used to actually measure the DV of this study, while the first measurement served as a variable whose effect this study could control for if significantly related to (one of) the dependent variables or the independent variable.

3.4.2.3 Measures of Team Performance

The DV *team performance* consisted of three separate measures: i) *time till completion*, ii) the *number of mistakes made*, and iii) the *number of missing parts*. As the words team performance already indicate, these outcomes were measured at the aggregate, team-level. How each of the outcomes was measured exactly is being discussed below.

Time till Completion. The time (in minutes) teams took to 'complete' the task was measured by means of an electronic egg-timer. Once the team members said they were done (or made this clear without using words), the egg-timer was stopped. The maximum time that teams could take was 15 minutes (i.e. the deadline). Teams that did not manage to finish the task in time received a score of 15 for time till completion. Scores could in theory range from 0 to 15. The higher the team score for time till completion, the longer the team took and, thus, the worse it performed.

Number of Mistakes made. For the second measure of team performance, the number of mistakes made, the telephones had to be rated after the experimental session. The experimenter disassembled the telephone and checked how many parts were used or assembled wrongly. The assembly task consisted of 34 separate actions (involving 30 parts and 23 screws = 53 items) during which mistakes could be made. Each mistake made was noted down on a performance evaluation form and in the end the mistakes made by the team were added together to make up a score for *number of mistakes made*. The higher the team score for this performance measure, the worse the team performed.

Scores could theoretically range from 0 to 53. However, 53 mistakes would mean that the team did not assemble a single item of the telephone kit and therefore, it would not be considered having made mistakes but as having 53 parts missing. This brings us to the final dependent variable, the number of missing parts.

Number of Missing Parts. To test for the number of parts missing, the experimenter rated the number of parts that the teams did not use for their assembly (i.e. the number of parts that were still lying in the box after the team said it had finished the task or when the 15 minute deadline had passed). This number was written down on a performance evaluation form. The higher the team score for *number of missing parts*, the worse the team performed.

3.4.3 Other Variables

The study would like to control for extraneous variables that could possibly influence the relationship between the independent variable (i.e. timing of team membership change) and the dependent variables. Experience in assembling telephones or similar objects and familiarity with team members, are examples of variables that might influence the relationship. Therefore, they might have to be controlled for. These, and other variables, were measured at the individual level by means of the questionnaires. Most of these individual responses were aggregated to make up a team-level score. If and how this was done is discussed below.

3.4.3.1 Familiarity with Electronic Assembly Tasks

Being familiar with a certain task might affect one's performance on that task. Therefore, familiarity with electronic assembly tasks was measured. Consequently, in case it is indeed correlated to one of the dependent variables, it is possible to control for the effect it has. *Familiarity with electronic assembly tasks* was measured by an aggregate and average score for the participants' overall knowledge of electronics and skill level for electronic kit assemblies. Both items on the questionnaire were rated on a 5-point Likert scale (i.e. 1 = beginner, ..., 5 = expert). These items were based on a measure of task familiarity used by Lewis et al. (2005, p.591).

By taking the weighted average of the team members' individual scores, the score for the team's familiarity with the task was calculated. This average was calculated by giving each individual score a weight that corresponds to the opportunity the team member had to affect the team's performance in the experiment. That is to say, the time that a participant was part of a certain team equals the opportunity he/she had to affect the team's performance. Hence, the weight attributed was based on the time spent in the respective team.

Based on this logic the following formula, (3.1), was designed to transform individual scores into an aggregate team-score for *familiarity with electronic assembly tasks*. This formula applies to teams in the membership change conditions.

$$\frac{(1*w) + ((1/3)*x) + (1*y) + ((2/3)*z)}{3} \qquad (3.1)$$

An example to illustrate this formula, a team in the early turnover condition had two constant team members, W and Y. Hence, the weight attributed to their individual score is 1 since they belonged 100% of the time to the given team. One team member, X, was taken out of the team after 5 minutes and was therefore attributed a weight of 1/3 since he/she belonged only 33.3% of the time to the particular team. Finally, a new team member, Z, came to replace team member X. The score of team member Z is given a weight of 2/3, since he/she was part of the team for 66.7% of the time, and this gave him/her more opportunity to affect the team's processes / performance than person X had. In the control groups no team membership took place. That is to say, each team member spent 100% of the time in the team. Therefore, team scores for teams in the control group were calculated by taking the average of the three team members' individual scores. The team scores for familiarity with the task ranged from 1 to 5. A higher team score indicates a greater level of prior experience with electronic assembly tasks within the group than does a lower score (Lewis et al., 2005).

3.4.3.2 Familiarity Working With Team Members

The familiarity working with the team members was measured as well, since it might affect group processes and performance. Familiar members deliver higher quality and are quicker in performing tasks (Harrison, Mohammed, McGrath, Florey & Vanderstoep, 2003). Moreover, previous research shows that familiar members are more likely to develop TMSs (Lewis, 2004) and that these team TMSs are likely to be more accurate and shared (Reagans et al., 2005).

To test for the familiarity of team members, each participant scored how often he/she had worked together with the other team members before on a 5-point Likert scale (i.e. 1 = not at all,...,5 = a lot). Subsequently, these scores were aggregated to constitute a team-score. Again, this was done by calculating a weighted average of team members' individual responses to Question 16 of Questionnaire 2 (see Appendix 9). In order to transform team members' individual scores into an aggregate team-score for *familiarity working with team members*, formula 3.2 (see below) was developed. This particular formula applies to teams belonging to the early team membership change condition.

$$(3.2)\qquad \frac{\begin{aligned} & 1(1\rightarrow3) + 1/3(1\rightarrow2) + 2/3(1\rightarrow5) \\ + \; & 1/3(2\rightarrow1) + 1/3(2\rightarrow3) \\ + \; & 1(3\rightarrow1) + 1/3(3\rightarrow2) + 2/3\,(3\rightarrow5) \\ + \; & 2/3(5\rightarrow1) + 2/3(5\rightarrow3) \end{aligned}}{6}$$

To illustrate this formula, in case of early team membership change, the team score for familiarity working together is composed of the individual responses of Persons 1, 2, 3 and 5. The relationship (x→y) means that this part of the formula is concerned with the response of person X to the question how often he/she has worked together with person Y before. The number before (x→y) denotes the weight given to this response. The weight corresponds the time spend together in the team and can therefore take on a value of 1, 2/3 or 1/3. Person 1 spent 100% of the time with Person 3, 33.3% of the time with Person 2 (i.e. in the early turnover condition this person was substituted for Person 5 after 5 minutes) and 66.7% of the time with Person 5. This is why the following weights were attributed to the responses of Person 1: 1(1→3) + 1/3(1→2) + 2/3(1→5). A similar logic applies to the weights attributed to the responses of Person 2, 3 and 5.

The team score for *familiarity working with team members* ranges from 1 to 5. High scores indicate that team members knew each other well; low scores indicate that the team members did not know one another before they took part in the experiment.

3.4.3.3 Extent Team Members Seem Familiar to Each Other

The extent to which team members seem familiar to each other was measured too, since this type of familiarity might also affect team processes and performance. This was measured at the individual level by means of an item on the questionnaire asking participants to rate the extent to which the other team members seemed familiar to him/her on a 5-point Likert scale (1 = not at all, ..., 5 = very). Then, the individual scores of the team members were transformed into a team-score by calculating the weighted average of the team members' ratings. The same formula as for calculating the team's familiarity working together is used for this calculation (i.e. formula 3.2). High scores indicate that team members seemed familiar to each other; low scores indicate that team members did not see one another before they took part in the experiment.

3.4.3.4 Individual and Collective Recall of the Task

Someone who can easily take in new information and who is able to recall this information when required might outperform people who have more difficulties doing this. This study would like to control for the potential effect of one's ability to recall information on performance. Hence, participants' individual and teams' collective recall of the assembly task were measured by means of an individual and a collective recall sheet.

The telephone assembly task consists of 10 steps, requiring 34 separate actions. First, participants were asked to recall these actions as accurately as possible and note them down on the recall sheet (see Appendix 8). Then, teams were asked to collectively recall the required actions too and note them down on the collective recall sheet. Afterwards, the answers given were analyzed and scored by the experimenter. For each step that was correctly remembered and written down at right step and the right action number the individual/team received 1 point. Further, one received 0.75 points for actions that were remembered correctly and written down at the right step but at the wrong action number, and 0.5 points for actions that were remembered correctly but written down at the wrong step and action number. The total amount of points awarded to the individual or team equals the score for their recall. The higher one scored on the individual/collective recall, the more information the individual/team recalled (correctly).

3.4.3.5 Stress

The extent to which people feel stressed may influence their behaviour and consequently their performance. Several team studies point to the negative effects of stress. For example, Driskell, Salas & Johnston (1999) state that stress affects team performance by causing a loss of team perspective and an increase in a more narrow self-focus. Moreover, previous research revealed that acute stress negatively impacts transactive memory and helped to explain why teams perform less when members experience acute stress (Ellis, 2006). Recently, however, researchers started to point out that stress leads to complex reactions in teams and that its effect on performance is not necessarily negative, depending on the kind of stressor that is introduced to the team (Pearsall, Ellis & Stein, 2009).

In order to test for stress and be able to control for its potential effects, stress was measured in this study as well. The level of stress participants experienced was measured by means of two items on the questionnaire. These items asked participants to rate the extent to which they agreed with the statement that they felt (time) pressured and stressed during the performance phase. Both items were measured on a 5-point Likert scale (i.e. 1 = strongly disagree, ..., 5 = strongly agree). The participant's score on the stress measure was calculated as the average of their scores on these two items. Subsequently, for each team the team members' individual scores on the stress measure were transformed into a team score for *stress* by calculating the weighted average of these scores. The formula used for this computation is the same as the one used for calculating the team score for familiarity with electronic assembly tasks (see formula 3.1).

3.4.3.6 Personality

One's personality characteristics are good indicators of the behaviour one is likely to portray in specific situations. That is to say, personality affects one's behaviour in situations like when working in teams and facing new or stressful situations and affects one's approach to team tasks. For instance, one's adaptability to change and new environments is dependent on personality (LePine, 2003; Levine & Moreland, 1999). Further, personality composition of teams may also affect TMS development (Uitdewilligen, Waller & Zijlstra, 2010) and performance (Van Vianen & De Dreu, 2001).

In this study the personality characteristics of participants might affect the ease with which the oldtimers adjusts to an unexpected change in team composition. Moreover, personality may affect the socialization process of newcomers, TMS development and team performance. Hence, each participant's personality was measured in terms of his/her extraversion, agreeableness, conscientiousness, emotional stability and intellect & openness. Saucier's (1994) Mini-Markers were used for this measurement, which is a less time-consuming and good alternative to Goldberg's extensive test of the Big Five; saving time and questionnaire space (Dwight, Cummings & Glenar, 1998). The Mini-Markers form a 40-item questionnaire that measures an individual's personality traits which are then translated into the five personality characteristics mentioned above. Each personality trait on the questionnaire is rated by means of a 9-point Likert scale (i.e. 1 = extremely inaccurate, ..., 9 = extremely accurate).

Subsequently, participants' scores for each personality characteristic were standardized to control for individual differences in the participants' use of the rating scale. This was done by converting the scores into Z-scores (like explained in Goldberg, 1992). The resulting scores for each of the five personality characteristics are included in the data-analysis (i.e. in the descriptive statistics and correlations) at the individual-level. No aggregate (team) score was calculated for *personality*.

3.4.3.7 Cohesiveness and Cooperation

Mutual trust and understanding help teams to coordinate their actions and are characteristics of cohesion. A cohesive team is characterized by, amongst others, its members' commitment to the group's task (Thompson, Peterson & Brodt, 1996). This commitment to the task and enhanced coordination may greatly benefit team performance (Wittenbaum et al., 1998). Since team cohesiveness may be very influential in terms of its positive effect on team processes and performance, a composite measure was built to test for teams' cohesion and cooperation. This measure was based on previous research and the items these studies used to measure cohesiveness in teams (Thompson et al., 1996; Peterson & Thompson, 1997).

The composite measure of team cohesion and cooperation consisted of six different items on the questionnaire asking the participant to rate the extent to which they felt that their team could be characterized as one that was (1) cohesive and in which (2) team members trusted each other's skills, were (3) familiar with each other's knowledge and skills, (4) shared their ideas and concerns, (5) communicated well and were (6) familiar with who was doing what and why. Each of these items was rated by the participants by means of a 5-point Likert scale (i.e. 1 = totally disagree,..., 5 = totally agree).

Then the individual score for *cohesiveness & cooperation* was calculated by taking the average of the participant's ratings given to the six items. The higher this score was, the more the individual characterized the team as cohesive and cooperative. However, this study is more interested in an aggregate for cohesiveness and cooperation, so that it can be included in the analysis at team level. Hence, the individual scores were converted into a team score by means of taking the weighted average of the team member's scores. Formula (3.1) is used for this conversion; the weight given to the team member's scores was determined by the time that the person was actually part of the respective team. The weight was thus representative of one's opportunity to affect the team's processes and performance as well as the likelihood that their perception of the cohesiveness and cooperation within the team was accurate. The final team score ranged between 1 and 5. The higher the team score for *cohesiveness & cooperation*, the more the team members perceived the team as being cohesive and cooperative.

3.4.3.8 Enjoyment

The extent to which employees enjoy their work is likely to affect the effort they put into it and their attitude towards the other team members. Therefore, the extent to which participants actually enjoyed performing the telephone assembly task may be related to team processes and performance. In order to test for this possible relationship, participants' enjoyment of the task was measured by means of a question on the questionnaire asking participants to rate the extent to which they agreed that performing the task was enjoyable on a 5-point Likert scale (i.e. 1 = strongly disagree, ..., 5 = strongly agree). Then, individual scores were translated into a team score for *enjoyment* by calculating the weighted average of the team members' individual scores. (For the exact formula, see formula (3.1))

Finally, several measures were designed to check whether the task was indeed perceived as difficult, complex, and requiring the division of labour and interdependent actions (i.e. whether teams were in fact interdependent) like is suggested by Lewis et.al (2007). These measures are discussed below.

3.4.3.9 Interdependence

Previous research points out that both task and reward interdependence may enhance effort and coordination, and therefore affect team performance (van der Vegt, Emans & van de Vliert, 1999) and TMS development (Wageman, 1995). Moreover, as mentioned before, Lewis et al. (2007) state that TMSs are relevant to the AK-750 telephone assembly task since it (1) requires division of labour and interdependent actions of all members to complete successfully (i.e. team members are task interdependent), and (2) is sufficiently complex in terms of possibility to make mistakes. To test whether these assumptions made about the task are right and to be able to control for the effect of interdependence on the dependent variables, if any, a measure of *interdependence*, consisting of three items on the questionnaire, was used. These items are based on questionnaire items used in previous research (Günter, Cuijpers & Uitdewilligen, forthcoming).

Together these items measure the extent to which the individual perceived their team to be interdependent in performing the task. In specific, participants indicated to which extent they believed that (1) they could not accomplish the task without the information and assistance of other team members, (2) the team members depended on him/her for information and assistance, and (3) the jobs performed by the team members were related to one another. Participants answered these questions by means of a 5-point Likert scale (i.e. 1 = strongly disagree, ..., 5 = strongly agree). The individuals' score on *interdependence* was calculated by taking the average of these three scores. Then, a team-score for *interdependence* was calculated by taking the weighted average of the team members' individual scores. The team scores range from 1 to 5; the higher the team's score, the more the team was perceived to be interdependent by its team members; lower scores indicate that team members did not think they needed the other members to accomplish the task successfully.

3.4.3.10 Complexity and Difficulty

The second assumption made about the telephone assembly task was that it is a complex task that offers enough possibilities for teams to make mistakes. To check for this second assumption, participants were asked to both rate the extent to which the agreed that the task was complex and difficult. Their responses were measured by means of a 5-point Likert scale (i.e. 1 = strongly disagree, ..., 5 = strongly agree). These individual scores were then transformed in to a team score for complexity and difficulty by taking the weighted average of the members' individual scores. Again, the weight attributed to a member's score depended on the time he/she spent in the team. In specific, in the control group each team member's score was given the weight of 1 and then divided by 3, while in the treatment conditions, team member's scores were multiplied by a weight of either 1/3, 2/3 or 1 and the total was then divided by 3 (see formula (3.1)).

3.5 Control Groups

As mentioned before, the participants had to complete a telephone assembly task in teams of three. The teams were trained together in performing the task. After this training, teams could practice the task for 20 minutes. Then, after this practice phase, teams had to perform the task within the 15-minute deadline. During this performance phase teams faced either early turnover (i.e. turnover during 'phase 1') or late turnover (i.e. turnover during 'phase 2').

In order to see whether the timing of turnover influenced the development of an accurate and shared team TMS and team performance, four teams were included in the control group. These teams did also go through the training, practice, and performance phases, but their team composition was not altered during the performance phase (i.e. these teams stayed intact from the beginning till the end of the experimental session). By including the control group, this study could assess whether the timing of turnover had a significant influence on the dependent variables of interest to this study.

4. Analysis and Results

This chapter describes the results of the data-analyses conducted for this study. First, the factor and reliability analyses ran to test for the internal consistency and accuracy of several questionnaire items are being discussed. Then, what follows is an outline of the descriptive statistics of the different variables. Subsequently the correlations among the variables will be shown and discussed. Finally, it is explained how each hypothesis was exactly tested and what the results are.

Before discussing of the data analyses, it should be mentioned that the data of one out of the 27 teams that took part in the experiment were removed from the dataset since the team completed the task within 10 minutes and could therefore not be subjected to the 'late team membership change'-condition it was initially assigned to. Another option would have been to include this team in the control condition. This would, however, have biased the results. Therefore, it was decided that this team had to be withdrawn from the analysis. The data of the remaining 26 teams were used for the subsequent data analysis.

The data to test for this study's hypotheses were partly obtained at the individual-level and in part at team-level (i.e. the dependent variables were measured at team-level). The factor and reliability analyses were carried out at the individual-level. The analyses for the descriptive statistics and correlations were carried out at both the individual and team-level. Since the hypotheses are tested at team-level, all individual measures were converted to team-level measures (as explained in the previous discussion of the measures). The hypotheses were tested by means of ANOVAs and ANCOVAs in combination with hierarchical linear regressions. All statistical tests were carried out using the SPSS 17.0 program.

4.1 Factor and Reliability Analysis

It is important to know whether the items on the questionnaires presumed to together measure a certain variable do indeed measure this construct. Moreover, if this is the case, it is also of importance to test whether the construct measured is reliable. This information is gathered by means of running a factor and reliability analyses (Field, 2009).

To validate the questionnaire items that were presumed to together measure a certain variable, a principal component analysis (PCA) without rotation was conducted on 16 items of the questionnaires (i.e. the items assumed to measure the constructs *stress*, *cohesiveness &*

cooperation, *interdependence*, and *familiarity with electronic assembly tasks*). Table 2 shows the component matrix without rotation together with the associated eigenvalues and Cronbach's alphas for each factor.

Principal Component Matrix				
Item: *Extent to which participant:...*	**Cohesiveness & Cooperation**	**Familiarity with task**	**Interdependence**	**Stress**
... has knowledge of electronics	-.04	.73	.36	.12
...is skilled in electronic kit assembly	.01	.75	.14	.14
... felt time pressure	.32	-.12	.52	.65
--- had stress feelings	.39	-.46	.04	.57
....thought task could not be accomplished without help/assistance team members	.22	-.54	.40	-.17
... others depended on him/her	.46	.10	.59	-.29
... believes team members' work was related	.52	-.03	.61	-.06
... enjoyed performing the task	.46	.23	.32	-.51
... found the assembly a complex task	.50	-.47	-.11	-.33
... found the assembly a difficult task	.55	-.51	-.09	.00
... thought the team was cohesive	.68	.12	-.23	.17
...understood what team members were doing	.44	.40	-.17	.02
... thought that the team communicated well	.70	.35	-.16	-.00
....trusted team members' skills	.64	.12	-.25	.02
.... thought the team members shared ideas and concerns	.55	.18	-.27	.18
... thought the team was familiar with each other's knowledge and skills	.47	.12	-.51	-.14
Eigenvalues	2.71	2.08	1.72	1.09
% of Variance	21.57	16.54	13.67	8.67
Cronbach's Alpha, α	.76	.84	.61	.63

Table 2: Summary of exploratory factor analysis results for the 16 questionnaire items (N=78)

The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis. KMO = .64, which is well above the acceptable limit of .5 (Field, 2009). Bartlett's test of sphericity, χ^2 (120) = 438.16, p <.001, indicated that correlations between items were sufficiently large for PCA. As explained by Field (2009, p.628), the fact that subsets of variables form clusters of large correlation coefficients indicates that these variables could be measuring characteristics of the same underlying dimension.

An initial analysis was run to obtain eigenvlaues for each component in the data. Four components had eigenvalues larger then Kaiser's criterion of 1 and in combination explained 60.45% of the variance. The items that cluster on the same components suggest that the first component represents *cohesiveness & cooperation*, the second component *familiarity with electronic assembly tasks*, the third component *interdependence*, and the fourth component *stress*. These findings validate the measures used for this study.

Next, the reliability of the scales of each of the four components was analyzed. The questionnaire may be assumed to have been reliable since none of the items greatly affected the overall reliability of any of the components. The variables *cohesiveness & cooperation* and *familiarity with the task* both had a high reliability, with Cronbach's α = .76 and .84 respectively. However, *interdependence* and *stress* had a relatively low reliability, with a Cronbach's α of .61 and .63 respectively.

4.2 Descriptive Statistics

Next the descriptive statistics are presented and discussed. Table 3 shows the descriptive statistics of the variables used in this study at the individual-level. The levels of kurtosis and skewness of these variables are different from 0, which indicates that the distribution of these variables may be significantly different from normal. However, tests for normality were conducted for the variables at team-level only, since the hypotheses are tested at this level as well.

Variable	Min.	Max.	Mean	Std. Dev.	Skewness	Kurtosis
Familiarity Task	1.00	5.00	1.87	.84	.97	1.01
Stress	1.00	5.00	3.32	.75	-.15	.41
Interdependence	1.00	5.00	3.83	.71	-1.02	2.43
Enjoy	1.00	5.00	3.86	.91	-.68	.35
Difficult	2.00	5.00	3.59	.92	-.12	-.76
Complex	2.00	5.00	3.91	.87	-.55	-.23
Cohesiveness & Cooperation	2.33	5.00	3.71	.57	.06	.10
Extraversion	3.75	9.00	6.33	1.12	-.23	-.27
Agreeableness	3.25	9.00	6.97	1.02	-.63	1.11
Conscientiousness	3.13	8.50	6.38	1.23	-.51	-.30
Emotional Stability	1.88	8.63	5.49	1.18	-.05	.38
Intellect & Openness	4.50	8.75	6.21	.95	.35	-.21
Individual recall	0.00	14.75	6.89	3.20	.08	-.39

Table 3: Descriptive Statistics: individual-level, N=78

On average, the participants were not very familiar with electronic assembly tasks (M = 1.86, S.D. = 0.84) and managed to recall only a few of the 34 actions correctly (M = 6.89, S.D. = 3.20). Moreover, the participants felt quite stressed when performing the task together with their team (M = 3.32, S.D. = 0.75) but did enjoy performing the task (M = 3.86, S.D. = 0.91). Further, taken together, the participants perceived the task as being quite difficult and complex (M = 3.59, S.D. = 0.92, and M = 3.91, S.D. = 0.87) and perceived their team as being rather interdependent (M = 3.83, S.D. = 0.71) and as a relatively cohesive and cooperative unit (M = 3.71, S.D. = 0.57). Interestingly, for all the variables mentioned here, both the minimum (or close to minimum) and maximum scores were given. This, together with standard deviations close to 1.00 show that participants varied in their opinions in terms of the difficulty, complexity, enjoyableness and stressfulness of the task.

In terms of personality characteristics, on average, the participants described themselves as being slightly extraverted (M = 6.33, S.D. = 1.12), conscientious (M = 6.38, S.D. = 1.23) and intellectual & open (M = 6.21, S.D. = 0.95). Moreover, they described themselves as being moderately agreeable (M = 6.97, S.D. = 1.02) and not emotionally stable nor emotionally instable (M = 5.49, S.D. = 1.18). However, it should be noted that individual scores on the five personality characteristics varied greatly, with differences between the minimum and maximum scores for each personality characteristic ranging between 4.25 (for Intellect & Openness) and 6.75 (for Emotional Stability).

Table 4 shows the descriptive statistics of variables of measured at the team-level. The table shows the statistics for all teams together (N = 26) and per treatment condition (N = 4, N = 12, and N = 10). Below the statistics for each variable are discussed, one by one. First the statistics for the variables that the study potentially would like to control for are discussed. Then, the discussion continues with the statistics for the dependent variables.

First, the teams were only somewhat familiar with the task (M = 1.87, S.D. = 0.36). Moreover, teams in the control condition (M = 2.13, S.D. = 0.32) were more familiar with electronic assembly tasks than teams in the early and late turnover conditions (M = 1.92, S.D. = 0.42 and M = 1.72, S.D. = 0.25 respectively). Further, overall, teams were only slightly familiar with their team members in terms of previous experience working together (M = 1.66, S.D. = 0.50) and the extent to which they seemed familiar to each other (M = 2.18, S.D. = 0.59). Teams in the control and late turnover conditions were similar in terms of their average experience working together (M = 1.71, S.D. = 0.55 and M = 1.72, S.D. = 0.57 respectively), while teams in the early turnover condition were slightly less familiar with working together compared to teams in the other two conditions (M = 1.60, S.D. = 0.45). With respect to the extent to which team members seemed familiar to each other, teams in the control condition seemed slightly more familiar to each other (M = 2.46, S.D. = 0.71) compared to teams in the turnover conditions (M = 2.15, S.D. = 0.70 and M = 2.11, S.D. = .40 respectively).

Stress scores ranged between 2.50 and 4.50. On average, teams felt slightly stressed during the performance phase (M = 3.32, S.D. = 0.43). Teams in the early turnover condition felt most stress (M = 3.43, S.D. = 0.50), while teams in the late turnover felt, on average, least stressed (M = 3.18, S.D. = 0.40).

		Min.	Max.	Mean	Std. Dev.	Skewness	Kurtosis
Familiarity Task	Total	1.17	2.72	1.87	0.36	0.53	0.43
	Control	1.67	2.33	2.13	0.32	-1.66	2.62
	Early	1.33	2.72	1.92	0.42	0.78	0.14
	Late	1.17	2.00	1.72	0.25	-1.25	1.84
Experience Working Together	Total	1.00	3.00	1.66	0.50	0.86	0.37
	Control	1.17	2.33	1.71	0.55	0.23	-3.87
	Early	1.11	2.39	1.60	0.45	0.64	-0.73
	Late	1.00	3.00	1.72	0.57	1.21	1.76
Team Members Seem Familiar	Total	1.11	3.61	2.18	0.59	0.66	0.56
	Control	1.67	3.33	2.46	0.71	0.29	-0.68
	Early	1.11	3.61	2.15	0.70	0.85	0.84
	Late	1.56	2.56	2.11	0.40	-0.44	-1.55
Stress	Total	2.50	4.50	3.32	0.43	0.33	1.45
	Control	3.17	3.67	3.33	0.24	1.41	1.50
	Early	2.72	4.50	3.43	0.50	0.68	0.69
	Late	2.50	3.61	3.18	0.40	-1.08	-0.21
Interdependence	Total	3.11	4.56	3.83	0.42	0.00	-0.85
	Control	3.11	4.56	3.69	0.64	1.01	0.28
	Early	3.41	4.52	3.98	0.39	-0.13	-1.46
	Late	3.15	4.11	3.71	0.34	-0.60	-0.66
Enjoy	Total	2.56	4.67	3.86	0.52	-0.92	0.56
	Control	3.33	4.67	4.00	0.61	0.00	-3.30
	Early	2.56	4.44	4.03	0.50	-2.63	8.05
	Late	2.78	4.11	3.60	0.44	-0.58	-0.40
Complex	Total	3.11	5.00	3.91	0.41	0.28	0.97
	Control	3.33	4.33	3.83	0.43	0.00	-1.20
	Early	3.67	5.00	4.11	0.33	1.85	4.71
	Late	3.11	4.44	3.70	0.41	0.33	-0.19
Difficult	Total	2.78	4.78	3.59	0.54	0.58	-0.24
	Control	3.00	4.33	3.50	0.58	1.54	2.89
	Early	3.11	4.67	3.78	0.43	0.55	0.30
	Late	2.78	4.78	3.40	0.61	1.38	1.97

Table 4: Descriptive Statistics: Team-level (Total: N=78, Control: N=4, Early: N=12, Late: N=10)

(Table continues on the next page)

		Min.	Max.	Mean	Std. Dev.	Skewness	Kurtosis
Cohesiveness & Cooperation	Total	3.20	4.59	3.71	0.34	0.67	0.51
	Control	3.44	4.17	3.82	0.30	-0.28	1.54
	Early	3.26	4.59	3.83	0.38	0.51	0.02
	Late	3.20	3.81	3.53	0.22	-0.22	-1.17
Collective Recall	Total	5.25	14.75	10.58	2.27	-0.38	-0.11
	Control	7.25	14.25	10.25	3.45	0.35	-3.96
	Early	5.25	14.75	10.94	2.42	-0.98	2.01
	Late	7.75	12.50	10.28	1.69	-0.20	-1.51
TMS sharedness after practice	Total	.24	.75	.48	0.12	0.12	-0.53
	Control	.30	.58	.40	0.13	1.09	-0.09
	Early	.24	.75	.51	0.14	0.05	-0.14
	Late	.32	.61	.48	0.10	-0.29	-1.24
TMS accuracy after practice	Total	2.57	4.10	3.25	0.38	0.32	-0.22
	Control	2.86	4.00	3.42	0.47	0.15	1.46
	Early	2.57	4.10	3.20	0.43	0.54	0.43
	Late	2.76	3.67	3.23	0.30	-0.09	-0.95
Time taken till 'completion'	Total	10.48	15.00	14.60	1.11	-3.18	9.60
	Control	10.48	15.00	12.98	2.37	-0.14	-5.19
	Early	15.00	15.00	15.00	0.00	.	.
	Late	14.08	15.00	14.77	0.38	-1.15	-0.67
No. of missing parts	Total	0	9	4.58	2.87	0.17	-1.02
	Control	0	8	3.75	3.86	0.17	-4.41
	Early	2	9	4.67	2.31	0.54	-0.48
	Late	0	9	4.80	3.33	0.17	-1.32
No. of mistakes made	Total	1	13	7.88	2.76	-0.40	0.17
	Control	1	8	5.25	2.99	-1.38	2.60
	Early	4	13	8.50	2.75	0.06	-0.89
	Late	4	11	8.20	2.30	-0.78	-0.35
TMS sharedness after performance	Total	.30	.81	.54	0.13	-0.18	-0.76
	Control	.36	.62	.50	0.10	-0.62	1.66
	Early	.30	.67	.52	0.13	-0.52	-1.42
	Late	.38	.81	.59	0.14	-0.23	-0.77
TMS accuracy after performance	Total	2.57	3.90	3.33	0.27	-0.53	1.38
	Control	3.10	3.90	3.45	0.34	0.85	1.78
	Early	2.57	3.71	3.29	0.32	-0.87	0.76
	Late	3.14	3.57	3.35	0.18	0.15	-2.01

Table 4 continued**: Descriptive Statistics: Team-level** (Total: N=78, Control: N=4, Early: N=12, Late: N=10)

Next, on average, teams perceived their team as being rather interdependent (M = 3.83). The perception of interdependence differed slightly between the treatment conditions however. On the whole, teams in the early turnover condition scored higher on *interdependence* (M = 3.98, S.D. = 0.39) than teams in the control and late turnover condition who scored fairly similar (M = 3.69, S.D. = 0.69 and M = 3.71, S.D. = 0.34 respectively).

Furthermore, generally speaking, teams enjoyed performing the task (M = 3.86, S.D. = 0.52). However, there exist differences between the teams in the different treatment conditions in terms of their enjoyment of the task. On average, teams in the control and early turnover conditions enjoyed the task more than the teams in the late turnover condition (M = 4.00, S.D. = 0.61 and M = 4.03, S.D. = 0.50 compared to M = 3.60, S.D = 0.44). Moreover, the team that enjoyed the task the least (scoring of 2.67 out of 5) was part of the early turnover condition and the team that enjoyed the task the most (scoring 4.67 out of 5) was part of the control condition.

In addition, teams found the task fairly difficult and complex (M = 3.59, S.D. = 0.54 and M = 3.91, S.D. = 0.41 respectively). On the whole, teams in the early turnover condition perceived the task as more difficult and complex than teams in the other two conditions (M = 3.78 and M = 4.11 compared to M = 3.50 and M = 3.83 for control condition and M = 3.40 and M = 3.70 for teams in the late turnover condition). The fact that teams perceived themselves as being rather interdependent and perceived the task as quite complex and difficult confirms the assumptions made by Lewis et al. (2007) about the telephone assembly task and, therefore, TMSs are indeed assumed to be relevant to this task.

Further, teams perceived themselves generally as being quite cohesive and cooperative (M = 3.71, S.D. = 0.34). However, teams in the late turnover condition were less cohesive and cooperative than teams in the other two treatment conditions (M = 3.53 compared to M = 3.82 and M = 3.83 for the control and early turnover condition respectively). In terms of the recall of the steps of the assembly task, on average teams scored 10.58 (S.D. = 2.27) out of 34. Teams in the early turnover condition recalled more information of the task than teams in the control and late turnover condition (M = 10.94 compared to M = 10.25 and M = 10.28 respectively).

Additionally, teams that faced early turnover had, on average, a more shared TMS after the practice phase than teams in the control and late turnover condition (M = 0.51 compared to M = 0.40 and M = 0.48 respectively). On the whole, teams had an average score of 0.48 (S.D. = 0.12) for TMS sharedness after practice and 3.25 (S.D. = 0.38) for TMS accuracy after practice. To be more precise, teams in the control condition had the most accurate TMS after practicing the task (M = 3.42, S.D. = 0.47), while teams in the two treatment conditions do not differ greatly in their scores for TMS accuracy after practice (M = 3.20, S.D. = 0.43 for teams in the early turnover condition and M = 3.23, S.D. = 0.30 for the late turnover condition). Next the descriptive statistics for the dependent variables measuring team performance, *TMS accuracy*, *TMS sharedness* are discussed

Dependent Variables. First, on average the teams took 14min36 to complete the assembly task in the performance phase (M = 14.60, S.D. = 1.11). However, teams in the control condition did, on the whole, perform the task quicker than teams belonging to the turnover conditions (M = 12.98, S.D. = 2.37 compared to M = 15.00, S.D. = 0.00 for the early and M = 14.77, S.D. = 0.38 for the late membership change condition). Interestingly, none of the 12 teams in the early membership change condition was able to finish the task within the 15 minutes deadline.

The *number of missing parts* was the second variable measuring team performance. On the whole, the teams had an average of 4.58 (S.D. = 2.87) parts missing. More precisely, teams in the control group had the least parts missing (M = 3.75, S.D. = 3.86), while teams in the late membership change condition had the most missing parts (M = 4.80, S.D. = 3.33). Teams in the early membership change condition had, on average, fewer parts missing than teams in the late membership change condition (M = 4.67, S.D. = 2.31) but more than the control group.

Furthermore, on average, teams made 7.88 (S.D. = 2.76) mistakes when performing the telephone assembly. Teams in the control group generally performed better than the teams in the treatment conditions. In specific, teams in the treatment conditions made, on average, around three mistakes more than teams in the control group (M = 5.25 for the control group and M = 8.50 and M = 8.20 for the early and late turnover condition respectively).

The final two dependent variables looked at the teams' TMSs in terms of their accuracy and sharedness. The average team scores for *TMS accuracy* and *TMS sharedness* after performance were 3.33 (S.D. = 0.27) and 0.54 (S.D. = 0.13). On average, teams in the control condition had the least shared TMS (M = 0.50) but the most accurate TMS (M = 3.45). Teams in the early turnover condition had more shared TMSs than teams in the control group, but less shared than teams in the late turnover condition (M = 0.52 for early turnover and M = 0.59 for late turnover). Moreover, teams in the early turnover condition had the least accurate TMSs (M = 3.29, S.D. = 0.32) and teams in the late turnover condition scored somewhere in between the control group and the early turnover condition in terms of their TMSs' accuracy (M = 3.35, S.D. = 0.18).

4.3 Correlations

Bivariate correlation analyses were conducted to see how the variables relate to one another and which variables' effects the study would like control for. A Pearson correlation analysis was conducted for both the variables measured at the individual-level as well as for the aggregate team-level variables. However, this analysis assumes that the sample data are normally distributed. Since not all the variables met this assumption of the Pearson correlation analysis, a Spearman's correlation analysis was run as well. The Spearman's correlation analysis is a non-parametric test that can be used to measure correlations between variables when the data violate parametric assumptions (Field, 2009).

Both the Pearson and Spearman's correlation analyses calculate correlation coefficients that lie between -1 and +1, indicating a perfect negative and a perfect positive relationship respectively. Values of 0 indicate that there is no relationship while values of .10 represent only small relationships between the two variables. Correlation coefficients of .30 and .50 represent medium-sized and strong relationships, in that order (Field, 2009). Since all hypotheses are directional, correlations were tested with one-tailed significance tests, reporting one-tailed probabilities.

This section discusses the most striking results of the Pearson and Spearman's correlation analyses for the variables measured at individual-level together with the dependent variables first. Then, what follows is a discussion of the correlation analyses for the aggregate, team-level variables.

4.3.1 Individual-Level variables

Table 5 and Table 6 show the correlation coefficients for both Pearson's and Spearman's correlation analysis for the individual-level variables. The most interesting results are mentioned here. The treatment teams received was negatively correlated *cohesiveness & cooperation* ($r = -.22$, and $r_s = -.19$, $p < .05$). That is to say, the timing of turnover seems to be negatively related to the cohesion and cooperativeness of the team, as perceived by the individual participants. Further, there was a significant negative relationship between the participants' age and the extent to which participants felt stressed, $r = -.26$, $p < .05$.

Moreover, less surprising is the fact that the individuals' *familiarity with electronic assembly tasks* is negatively correlated to the extent to which the participant found the task *difficult* and *complex* ($r = -0.25$, $p < .05$ and $r = -0.24$, $p < .05$ respectively) and positively correlated to the *individual's recall* of the task ($r = 0.25$, $p < .05$ and $r_s = 0.29$, $p < .01$). A surprising finding, on the other hand, is the negative relation between *cohesiveness & cooperation* and *TMS sharedness after practice*, r = -.30 and r_s = -.34 p < .01.

Correlations (Pearson's r)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Treatment	--																								
2. Age (Yr)	.12	--																							
3. Gender	.16	-.20*	--																						
4. Field of Study	.12	-.15	.22*	--																					
5. Nationality	.08	-.07	.09	.16	--																				
6. Familiarity Task	-.17	.09	-.28**	.05	-.19	(.84)																			
7. Stress	-.11	-.26*	.05	-.17	-.21*	-.11	(.63)																		
8. Interdependence	-.05	-.10	.14	.00	-.19*	-.07	.28**	(.61)																	
9. Enjoyment	-.19*	.11	-.04	.03	-.14	.13	-.03	.37**	--																
10. Complexity	-.12	.02	.19*	-.04	-.07	-.25*	.14	.23*	.23*	--															
11. Difficulty	-.09	-.01	.24*	.00	-.03	-.24*	.35**	.24*	.05	.70**	--														
12. Cohesiveness & Cooperation	-.22*	-.08	.21*	.09	.10	.07	.13	.12	.25*	.22*	.26*	(.76)													
13. Time taken till 'completion'	.41**	-.02	.03	.14	-.27**	-.13	.07	.11	.02	.07	.10	-.14	--												
14. No. of missing parts	.11	.00	-.01	.12	-.05	-.07	-.03	-.00	-.17	-.02	.06	-.20*	.49**	--											
15. No. of mistakes made	.28**	-.06	.03	.20*	-.07	-.15	.10	.06	-.18	.13	.10	-.02	.50**	.21*	--										
16. TMS sharedness after practice	.15	.18	.11	-.01	-.37**	-.03	-.08	-.06	-.18	.08	.14	-.30**	.42**	.13	.23*	--									
17. TMS accuracy after practice	-.12	.19	-.16	-.08	-.05	.18	.06	-.12	.12	-.13	-.19	-.07	-.12	-.02	-.27**	.10	--								
18. TMS sharedness after performance	.28**	-.03	.08	.14	.04	.04	-.12	-.03	-.14	-.08	-.03	-.06	.26*	-.12	.18	.43**	.02	--							
19. TMS accuracy after performance	-.08	-.15	.02	-.01	.01	.12	.14	.17	.01	.12	.07	.01	-.16	-.23*	.33**	.03	-.12	.40**	--						
20. Individual recall	-.12	-.05	.10	-.04	-.13	.25*	-.01	.20*	.35**	.19*	.08	.14	.01	-.17	-.10	.15	.08	.19	.20*	--					
21. Extraversion(Z)	-.09	-.01	-.08	-.14	-.14	.27**	.03	.06	.21*	.07	.01	-.07	.07	.01	.06	.06	-.02	-.09	.05	.05	--				
22. Agreeableness(Z)	-.18	-.04	.15	.04	-.17	.08	.16	.28**	.31**	.26*	.22*	.15	.05	.02	.04	-.00	.15	-.05	.30**	.11	.43**	--			
23. Conscientiousness (Z)	-.16	.14	-.15	-.12	.03	.12	.01	-.06	.03	.18	.13	.24*	-.07	.03	.14	-.03	.10	-.16	.01	-.10	.20*	.20*	--		
24. Emotional Stability(Z)	-.13	.06	-.14	-.18	-.17	.07	-.18	.13	.11	.13	.00	-.09	.16	.08	.07	.14	.02	-.08	.02	.05	.41**	.53**	.18	--	
25. Intellect & Openness(Z)	-.14	.17	-.13	.03	.00	.12	-.02	.37**	.11	.08	.15	-.01	-.01	.04	.11	.04	-.02	-.00	.21*	.09	.20*	.25*	.18	.25*	--

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

(..) = Cronbach's α

Table 5: Pearson Correlation Coefficients: Individual-level (N=78).

Correlations (Spearman's rho, r_s)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Treatment	--																								
2. Age (Yr)	.55	--																							
3. Gender	.16	-.12	--																						
4. Field of Study	.13	-.20*	.13	--																					
5. Nationality	.11	-.09	.08	.17	--																				
6. Familiarity Task	-.12	.11	-.30**	.08	-.22*	(.84)																			
7. Stress	-.10	-.24*	.08	-.13	-.21*	-.21*	(.63)																		
8. Interdependence	-.14	-.05	.06	-.02	-.20*	.04	.11	(.61)																	
9. Enjoyment	-.18	.10	-.01	.07	-.13	.17	-.02	.45**	--																
10. Complexity	-.13	.03	.15	-.09	-.05	-.23*	.16	.28**	.28**	--															
11. Difficulty	-.12	.01	.22*	-.11	-.04	-.23*	.35**	.23*	.09	.66**	--														
12. Cohesiveness & Cooperation	-.19*	-.06	.21*	.11	.17	.01	.10	.07	.23*	.12	.21*	(.76)													
13. Time taken till 'completion'	.03	-.12	-.06	.15	-.20*	.06	.06	.04	.03	-.04	-.02	-.15	--												
14. No. of missing parts	.10	-.06	-.02	.22*	-.05	-.01	.03	.03	-.13	.00	.06	-.20*	.60**	--											
15. No. of mistakes made	.24*	-.01	.04	.15	-.04	-.09	.07	-.05	-.18	.08	.08	-.05	.30**	.22*	--										
16. TMS sharedness after practice	.14	.22*	.12	-.11	-.38**	-.00	-.09	-.03	-.17	.06	.11	-.34**	.34**	.11	.22*	--									
17. TMS accuracy after practice	-.08	.15	-.16	-.04	.03	.18	.08	-.09	.12	-.10	-.17	-.03	-.15	-.10	-.29**	.05	--								
18. TMS sharedness after performance	.32**	.03	.07	.08	.03	.09	-.12	-.16	-.13	-.09	-.03	-.05	.25*	-.07	.18	.45**	.03	--							
19. TMS accuracy after performance	-.01	-.03	-.01	-.10	-.03	.12	.08	.09	.03	.16	.12	-.06	-.19	-.07	.34**	.08	-.08	.34**	--						
20. Individual recall	-.16	-.07	.10	-.04	-.13	.29**	-.04	.15	.38**	.16	.06	.14	-.00	-.14	-.12	.13	.07	.17	.20*	--					
21. Extraversion(Z)	-.13	-.07	-.10	-.16	-.15	.30**	-.04	.11	.24*	.11	.03	-.08	.10	.00	.06	.01	-.02	-.08	.10	.10	--				
22. Agreeableness(Z)	-.23*	.02	.13	.02	-.17	.04	.06	.19*	.33**	.31**	.22*	.04	.03	.10	-.00	.01	.08	-.12	.26*	.09	.50**	--			
23. Conscientiousness (Z)	-.18	.14	-.13	-.12	-.02	.13	-.02	-.01	.06	.17	.12	.18	-.05	.04	.15	-.02	.06	-.14	.08	-.09	.27**	.24*	--		
24. Emotional Stability(Z)	-.17	.03	-.13	-.26*	-.15	.06	-.23*	.19*	.13	.14	.03	-.09	.05	.05	.02	.12	-.09	-.12	.09	.07	.39**	.54**	.20*	--	
25. Intellect & Openness(Z)	-.17	.12	-.09	.00	-.01	.14	-.06	.35**	.10	.06	.15	.01	.02	.05	.08	-.00	-.08	-.06	.26*	.10	.20*	.25*	.18	.23*	--

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

(..) = Cronbach's α

Table 6: Spearman's Correlation Coefficients: Individual-level (N=78)

4.3.2 Team-Level Variables

Table 7 and Table 8 show the correlation coefficients for both Pearson's and Spearman's correlation analysis for the aggregate, team-level variables. First, what is interesting to notice is that *stress* was not significantly correlated to the treatment ($r = -.18$ and $r_s = -.08$, $p > .05$). That is to say, teams in the turnover conditions experienced less stress than teams in the control group while one would expect this relationship, though not significant, to be in the other direction. This because the unexpected change of team composition may lead to stress feelings.

Moreover, the experimental treatment was negatively correlated to the *enjoyment* of the task and *cohesiveness & cooperation*, but positively to *time till completion*. Teams in the turnover conditions found the task less enjoyable ($r = -.34$ and $r_s = -.43$, $p < .05$) and were perceived as less cohesive and cooperative ($r = -.37$ and $r_s = -.42$, $p < .05$). The Pearson correlation coefficient shows that treatment was positively correlated to the time the team took to complete the task ($r = 0.41$, $p < .05$), but the Spearman's correlation analysis found this relationship to be insignificant ($r_s = .03$, $p > .05$).

Teams' *familiarity with the task* is positively correlated to the *collective recall* of the task ($r = .40$ and $r_s = 0.37$, $p < .05$) and negatively correlated to the performance measures *time till completion* and the *number of mistakes made*, $r = -.33$, $p <. 05$ and $r = -.40$ and $r_s = -.41$, $p < .05$ respectively. The Spearman's correlation analysis found the relationship between *familiarity with the task* and *time till completion* to be insignificant, but its correlation to the performance measure *number of missing parts* significant, $r_s = -.37$, $p < .05$.

Correlations (Pearson's r)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Treatment	--																	
2. Familiarity Task	-.40*	(.84)																
3. Experience Working Together	.05	-.25	--															
4. Seem Familiar	-.17	-.02	.58**	--														
5. Stress	-.18	.12	.31	.14	(.63)													
6. Interdependence	-.09	-.03	.26	.20	.26	(.61)												
7. Enjoyment	-.34*	.27	.00	.16	.11	.50**	--											
8. Complexity	-.25	.15	-.10	.07	.03	.50**	.36*	--										
9. Difficulty	-.16	.19	.05	.06	.27	.46**	.17	.74**	--									
10. Cohesiveness & Cooperation	-.37*	.30	-.02	.18	.08	-.01	.32	.09	.24	(.76)								
11. Time taken till 'completion'	.41*	-.33*	.28	-.08	.09	.19	.07	.19	.21	-.17	--							
12. No. of missing parts	.11	-.31	.46**	.03	-.08	.05	-.18	.21	.25	-.09	.49**	--						
13. No. of mistakes made	.28	-.40*	.05	.09	.07	-.02	-.33	.26	.20	-.05	.50**	.21	--					
14. TMS Sharedness after Practice	.15	.21	-.15	-.19	-.02	.07	-.27	.23	.24	-.31	.41*	.18	.36*	--				
15. TMS Accuracy after Practice	-.12	.29	-.16	-.02	.05	-.43*	.08	-.24	-.27	-.11	-.13	-.07	-.36*	.10	--			
16. TMS Sharedness after Performance	.28	.11	-.26	-.18	-.26	-.12	-.24	-.19	-.06	-.19	.26	-.12	.18	.57**	-.16	--		
17. TMS Accuracy after Performance	-.08	.19	-.19	.13	.16	.11	-.10	.19	.11	-.10	-.16	-.23	.33*	.24	-.30	.40*	--	
18. Collective Recall	-.04	.40*	-.01	.25	.13	.01	.09	.08	.08	.19	-.00	-.27	-.02	-.06	.22	-.04	.21	--

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

(..) = Cronbach's α

Table 7: Pearson Correlation Coefficients: Team-level (N=26)

Next, interestingly the teams' *experience working together* is positively related to the *number of missing parts*, $r = .46$, $p <. 01$ and $r_s = 0.39$, $p < .05$. Thus, the telephones of teams with more experiences working together, had more parts missing than those of teams with less experience working together. Further, *enjoyment* is negatively related to the number of mistakes made, $r_s = -.37$, $p < .05$. Teams that enjoyed the task more made fewer mistakes than teams that enjoyed the task less. This finding was confirmed by the Spearman's correlation analysis only.

Furthermore, *time till completion* is positively related to the other two performance measures ($r = .50$ and $r = .49$, $p < .01$ respectively), but only the relation to the number of missing parts is confirmed by the non-parametric test ($r_s = .60$, $p < .05$). Next, it is interesting to see that *TMS sharedness after practice* and *TMS sharedness after performance* are positively correlated ($r = .57$ and $r_s = .54$, $p <. 01$), while *TMS accuracy after practice* and *TMS accuracy after performance* are not significantly related at all.

Correlations (Spearman's rho, r_s)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Treatment	--																	
2. Familiarity Task	-.38*	(.84)																
3. Experience Working Together	.05	-.14	--															
4. Seem Familiar	-.08	.01	.70**	--														
5. Stress	-.08	.08	.35*	.12	(.63)													
6. Interdependence	-.08	-.11	.29	.23	.26	(.61)												
7. Enjoyment	-.43*	.25	-.08	.17	.03	.55**	--											
8. Complexity	-.31	-.06	-.09	.05	-.00	.50**	.48**	--										
9. Difficulty	-.24	.09	.10	.02	.26	.45*	.24	.69**	--									
10. Cohesiveness & Cooperation	-.42*	.28	.02	.12	.02	.06	.33	.10	.33*	(.76)								
11. Time taken till 'completion'	.03	-.14	.31	.06	.08	.11	.14	.02	.14	-.00	--							
12. No. of missing parts	.10	-.37*	.39*	.14	.03	.01	-.15	.10	.25	-.11	.60**	--						
13. No. of mistakes made	.24	-.41*	.10	.04	.05	-.06	-.37*	.23	.18	-.06	.30	.22	--					
14. TMS Sharedness after Practice	.14	.02	-.12	-.24	-.03	.06	-.29	.08	.20	-.44*	.32	.15	.35*	--				
15. TMS Accuracy after Practice	-.08	.33*	-.15	-.04	.03	-.39*	-.02	-.31	-.24	-.05	-.22	-.19	-.39*	.05	--			
16. TMS Sharedness after Performance	.32	.10	-.24	-.25	-.15	-.16	-.28	-.29	-.06	-.24	.25	-.07	.18	.54**	-.17	--		
17. TMS Accuracy after Performance	-.01	.05	-.26	.03	.16	.07	-.09	.26	.11	-.26	-.19	-.07	.34*	.28	-.19	.34*	--	
18. Collective Recall	-.07	.37*	.05	.08	.16	.02	.10	.08	.07	.12	-.04	-.31	-.10	-.05	.26	-.03	.07	--

*. Correlation is significant at the 0.05 level (1-tailed).

**. Correlation is significant at the 0.01 level (1-tailed).

(..) = Cronbach's α

Table 8: Spearman's Correlation Coefficients: Team-level (N=26)

Now that the descriptive statistics of the variables have been discussed, the discussion turns to the results of the statistical tests used to decide whether any differences that exist between the three groups in this study are significant and check whether our experimental hypotheses are confirmed or not

4.4 Tests of Normality and Homogeneity of Variance

Before running a one-way ANOVA to test whether the experimental manipulation (i.e. timing of turnover) has had some effect, one has to be sure that the data meet the assumptions of parametric tests like the ANOVA. First, the distributions within groups should be normally distributed. Non-normally distributed data could pose a problem to this study, since this could cause difficulties in the interpretability and reliability of parametric test results.

Looking at Table 4, showing the descriptive statistics of the variables, it is evident that the levels of kurtosis and skewness of the variables are different from 0. This indicates that the distribution of the data sample may be non-normal (i.e. is non-symmetric and has either too thick or too thin tails compared to a perfect normal distribution (Field, 2009)). Hence, some tests were conducted to see whether these variables were normally distributed or not.

To begin with, a visual check for normal distribution was done by plotting the frequency distribution histogram together with a normal distribution curve for each variable. This way one can see whether the distribution looks roughly normal or not. This test showed that none of the variables was perfectly normally distributed. Some seemed to be close to normally distributed (e.g. familiarity with the task and enjoyment of the task), whereas other variables seemed to be far from normally distributed (e.g. cohesiveness & cooperation, time till completion and the number of missing parts).

Apart from this visual check, tests of normality were run for the variables measured at team-level in order to see whether the data were significantly different from a normal distribution (see Appendix 11). The results of the Kolmogorov-Smirnov test show that the distribution of the sample were significantly different from a normal distribution only for *enjoyment* ($D(26) = .18$, $p = .03$), *time till completion* ($D(26) = .45$, $p = .00$), and *TMS accuracy after practice* ($D(26) = .19$, $p = .01$). Interestingly though, the result of the Shapiro-Wilk test show that only *time till completion* is significantly different from a normal distribution ($W(26) = .42$, $p = .00$) and that the distribution of the scores for *enjoyment* and *TMS sharedness after practice* are not significantly non-normal ($W(26) = .93$, $p = .09$ and $W(26) = .95$, $p = .20$ respectively).

Since the data sample is not normally distributed for each variable used in the study, the results indicate that one should be cautious interpreting results of parametric statistical tests, such as ANOVA and ANCOVA. However, before jumping to conclusions about the distribution of the data, it is important to look at the distribution in each group rather than at the distribution of the overall distribution, this because this thesis compares groups (i.e. control, early turnover and late turnover) (Field, 2009). Hence, tests for normality were also run for each group separately (see Appendix 12 for the exact results).

The results of the Kolmogorov-Smirnov test ran within groups show that the scores on the variables *enjoyment* ($D(12) = 0.31$, $p = .00$), *complexity* ($D(12) = 0.30$, $p = .00$) and *TMS sharedness after performance* ($D(12) = 0.28$, $p = .01$) were significantly non-normally distributed in the early turnover group. The results of the Shapiro-Wilk test confirmed the findings of the Kolmogorov-Smirnov test for the variables *enjoyment* ($W(12) = 0.68$, $p = .00$) and *complexity* ($W(12) = 0.78$, $p = .01$), but did not find the distribution of *TMS sharedness after performance* in the early turnover group to be significantly different from normal ($W(12) = 0.88$, $p = .08$). Moreover, it should be noted that for the early turnover group the test of normality was omitted for *time till completion* since all the teams in the early turnover condition took 15 minutes to ‘complete’ the task, and is thus not normally distributed.

Finally, regarding the late turnover group, the Kolmogorov-Smirnov test indicates that the scores on the performance measure *time till completion* were not normally distributed ($D(10) = 0.43$, $p = .00$) and this finding was confirmed by the results of the Shapiro-Wilk test as well ($W(10) = 0.64$, p =. 00). Moreover, this latter test indicated that the distribution of the *stress* scores of this group was significantly different from normal ($W(10) = 0.83$, $p = .03$).

To sum up, the normality assumption of parametric tests was violated by the data for the variables *enjoyment*, *complexity*, *TMS sharedness after practice*, *time till completion* and *TMS sharedness after performance*. Together these findings point out the need to be careful in interpreting results of further tests assuming normal distribution, and the possible necessity of conducting non-parametric tests, like the Kruskal-Wallis test, instead.

Homogeneity of Variance

The second assumption of parametric tests that should be checked for is the assumption of homogeneity of variance. Homogeneity of variance, in this case, means that the variance of the variables should be the same in each of the three experimental conditions (i.e. control, early turnover and late turnover) (Field, 2009). This second assumption was tested for by means of the Levene's test (see Appendix 13).

The results of the Levene's test indicate that only the variances of the variable *time till completion* were significantly different in the treatment groups, $F(1,12) = 138.19$, $p = .00$. Therefore, for time till completion the second assumption of parametric tests was violated too, and the data should thus be analyzed further by means of the non-parametric counterpart of ANOVA, the Kruskal-Wallis test.

For all other variables (i.e. both potential control variables and the dependent variables) homogeneity of variance is assumed since the results of their Levene's tests were not significant (i.e. their p-values ranged from .15 to .77). Now that the assumptions of normality and homogeneity of variance have been tested for, we turn to the discussion of the hypotheses tests.

4.5 One-way ANOVA and Kruskal-Wallis Tests

To test for our hypotheses and, thus, to see whether the timing of turnover led to differences in the dependent variables of interest to this study, a one-way ANOVA was ran and led to the following results (see Appendix 14). Since all hypotheses are directional, results are reported together with their one-tailed probabilities.

First, the test results show that timing of turnover had no significant effect on TMS accuracy, $F(2,23) = 0.50$, $p = .61$, $\omega = .20$. Planned contrasts reveal that undergoing team membership change did not significantly decrease a team's TMS accuracy compared to not undergoing team membership change, $t(23) = -0.87$, $p = .19$, $r = .18$. Moreover, late turnover did not significantly increase TMS accuracy compared to early turnover, $t(23) = 0.45$, $p = .32$, $r = .09$. Hence, these results did not support Hypothesis 1.

Second, there was no significant effect of timing of turnover on TMS sharedness $F(2,23) = 1.16$, $p = .33$, $\omega = .00$. Moreover, undergoing team membership change did not significantly increase TMS sharedness compared to not undergoing team membership change, ($t(23) = 0.76$, $p = .23$, $r = .16$) and late turnover did not significantly increase TMS sharedness compared to early turnover, $t(23) = 1.35$, $p = .09$, $r = .27$. Hypothesis 2 is, therefore, not supported.

However, since the normality assumption was violated for TMS sharedness, according to the results of the Kolmogorov-Smirnov test results, and group sizes were unequal, the power and accuracy of F may be affected in quite unpredictable ways (Field, 2009). Hence, a Kruskal-Wallis test was ran to test whether group means for TMS sharedness were significantly affected by timing of turnover and this analysis led to the following results.

TMS sharedness was not significantly affected by timing of turnover, $H(2) = 2.66$, $p = .26$, which confirms the findings of the ANOVA. Mann-Whitney tests were used to follow up this finding. A Bonferrioni correction was applied and so all effects are reported at the .0167 (i.e. .05/3) significance level. TMS sharedness was found to be no different when teams underwent early or late team membership change ($U = 22$, $r = -.06$ and $U = 1$, $r = -.34$) compared to the control group. Neither was TMS sharedness significantly different when early team membership change was compared to late team membership change ($U = 38.50$, $r = -.30$). The Jonckheere's test revealed a non-significant trend in the data: the later team composition is altered, the more shared a team's TMS gets, $J = 136.50$, $z = 1.57$, $r = .31$. Hence, the results of the Kruskal-Wallis test support the conclusions drawn from the ANOVA; Hypothesis 2 is not supported.

Third, there was a significant effect of timing of turnover on the time needed to complete the task, $F(2,23) = 8.06$, $p < .01$, $\omega = .59$. Planned contrasts revealed that undergoing team membership change significantly increased time taken till completion of the task, $t(23) = 3.94$, $p < .01$, $r = .63$, and undergoing late team membership change did not significantly decrease time taken till completion compared to teams facing early team membership change, $t(23) = -.62$, $p = .27$, $r = .13$. These results do only partially support Hypothesis 3, regarding time till completion. However, since the normality assumption was violated for time taken till completion and group sizes were unequal, a Kruskal-Wallis test was ran to test whether group means were significantly affected by timing of turnover and this analysis led to the following results.

Time taken till completion was significantly affected by timing of turnover, $H(2) = 6.40$, $p < .05$. Mann-Whitney tests were used to follow up this finding. A Bonferrioni correction was applied and so all effects are reported at a .0167 (i.e. .05/3) significance level. The time teams took to complete the task was found to be significantly longer for teams that underwent early turnover compared to the control condition, $U = 12$, $r = -.63$. However, the time teams took to accomplish the task was no different when early turnover was compared to late turnover ($U = 13$, $r = -.31$) and when late team membership change was compared to the control condition ($U = 42$, $r = -.42$). Moreover, the Jonckheere's test revealed a non-significant trend in the data: the later team composition was altered, the more time teams took, J = 105, z = 0.07, r =.01. Therefore, the results of the Kruskal-Wallis test confirm the results of the ANOVA, that Hypothesis 3 regarding time till completion is only partially supported.

Fourth, timing of turnover had a non-significant effect on the number of mistakes made, $F(2,23) = 2.43$, $p = .11$, $\omega = .32$. Nonetheless, the planned contrasts reveal that facing team membership change significantly increased the number of mistakes made compared to teams that remained intact, $t(23) = 2.18$, $p < .05$, $r = .41$. However, late turnover did not significantly decrease the number of mistakes made compared to facing early turnover, $t(23) = -0.27$, $p = .39$, $r = .06$. Hence, Hypothesis 3 with respect to the number of mistakes made was only partially supported here.

Finally, the one-way ANOVA indicates that there was no significant effect of timing of turnover on the number of parts that teams did not use when performing the task, $F(2,34) = .19$, $p=.83$, $\omega = .26$. Turnover did not significantly increase the number of parts that were missing compared to the control group, $t(23) = 0.61$, $p = .27$, $r = .13$, and late turnover did not significantly increase the number of parts missing either, $t(23) = 0.10$, $p = .46$, $r = .02$. Therefore, Hypothesis 3 concerning the number of parts missing is not supported by this analysis.

4.6. ANCOVAs

In order to draw more precise conclusions about the effect that timing of turnover has on the different dependent variables in this study, one may decide to control for the effect of other (extraneous) variables. Hence, the hypotheses were tested using ANCOVAs, since these tests allow for the control for a covariates' effects on the dependent variable and examine how much of the residual variance in the dependent variable can be explained by the experimental treatment (i.e. the independent variable timing of turnover) (Field & Hole, 2003).

Before deciding which variables to include in the ANCOVAs, an ANOVA was run for the variables that classified to be included based on their significant correlations to the independent and/or the dependent variables. That is to say, the variables *familiarity with the task*, *enjoyment*, *cohesiveness & cooperation*, *TMS sharedness after practice* and *experience working together* were subjected to an ANOVA based on their correlations to the treatment and/or to (one of) the dependent variables. This in order to check whether these variables do meet the assumption of independence of the covariate and treatment effect and could, thus, indeed be included as covariates in the analyses. When groups do not differ on the covariate, then they can be used as covariates in the hypothesis testing (Field, 2009).

Results of the ANOVA and the associated planned contrasts show that the team's *familiarity with the task* did not significantly differ between groups, $t(23) = -1.63$, $p > .05$ and $t(23) = -1.34$, $p > .05$. Second, the team's *TMS sharedness after practice*, $t(23) = 1.36$, $p > .05$ and $t(23) = -0.42$, $p > .05$, also met this criterion of independence from the treatment effect. The last variable that passed the test was team's *experience working together*, $t(23) = -0.17$, $p > .05$ and $t(23) = 0.55$, $p > .05$.

Moreover, teams that experienced early turnover were significantly different from teams that underwent late turnover in terms of the extent to which they enjoyed performing the task, $t(23) = -2.03$, $p < .05$, and the extent to which they perceived their team as a cohesive and cooperative unit, $t(23) = -2.18$, $p < .05$. Therefore, these two variables cannot be included in the ANCOVAs. Hence, teams' *familiarity with the task, TMS sharedness after practice* and *experience working together* were the only three variables included in the ANCOVAs testing for Hypothesis 1 till 4. Table 9 provides an overview of the exact variables included in the analyses testing for the hypotheses.

	Independent Variable	Dependent Variable(s)	Covariate(s)	Mediating Variable(s)
H1	Timing of Turnover	TMS accuracy	Familiarity Task	X
H2	Timing of Turnover	TMS sharedness	Familiarity Task TMS sharedness after practice *	X
H3 i)	Timing of Turnover	Time till completion	Familiarity Task	X
H3 ii)	Timing of Turnover	Number of mistakes made	Familiarity Task	X
H3 iii)	Timing of Turnover	Number of missing parts	Familiarity Task Experience Working Together *	X
H4	Timing of Turnover	Team performance: i) Time till Completion ii) Number of Mistakes made iii) Number of Missing parts	X	TMS accuracy TMS sharedness

***** = covariate used in trimmed model

Table 9: Variables included in the analyses

4.6.1 Hypothesis 1

Hypothesis 1 states that turnover is negatively related to the accuracy of a team's TMS, and that teams that faced change in their team composition before the midpoint of their existence will have more accurate TMSs than teams that faced turnover after this midpoint. Specifically, teams in the control group are assumed to have the most accurate TMSs, followed by teams in the early turnover condition and late turnover condition, in this respective order.

To test for this hypothesis an ANCOVA was ran with team's *familiarity with electronic assembly tasks* as a covariate. Both the homogeneity of regression slopes and the homogeneity of variance assumption were met. In detail, the effect of the independent interaction term was not significant, $F(2,20) = 0.01$, $p = .99$, and the Levene's test for this analysis reveals that the variance in TMS accuracy was not significantly different between groups, $L(2,23) = .90$, $p = .35$. Hence, because these two assumptions are met, the use of an ANCOVA, a parametric test, to test for Hypothesis 1 is justified.

The results of this analysis show that the covariate, team's *familiarity with electronic assembly tasks*, was positively but not significantly related to *TMS accuracy*, $\beta = 0.14$, $F(1,22) = 0.71$, $p = .41$, $r = .18$, partial $\eta^2 = .03$. Moreover, after controlling for the effect of team's familiarity with the task, the effect of timing of turnover on team TMS accuracy was still non-significant, $F(2,22) = 0.42$, $p = .66$, partial $\eta^2 = .04$.

To interpret the main effect of timing of turnover on TMS accuracy, or any of the other dependent variables in this study, one needs to look at the adjusted means. These are the group means that are adjusted for whatever effect the covariate(s) has (have) on the dependent variable (Field, 2009). Table 10 reports the unadjusted and adjusted group means for TMS accuracy. As said, the adjusted group means are adjusted for the covariate's effect on TMS accuracy; in this case that is the effect of the teams' familiarity with electronic assembly tasks. By make use planned contrast in SPSS one can easily check whether the differences between adjusted group means are significant or not.

The planned contrasts reveal that undergoing early or late team membership change did not significantly decrease team TMS accuracy, $\beta = -0.13$, $t(22) = -0.78$, $p = .44$, $r = .16$ and $\beta = -0.05$, $t(22) = -0.26$, $p = .80$, $r = .05$ respectively. These results do not support Hypothesis 1_a, since even though the relationships found were in the hypothesized direction, they were not significant.

TMS Accuracy		
Group Mean:	Unadjusted	Adjusted
Control	3.45	3.41
Early	3.29	3.29
Late	3.35	3.37

Table 10: Group means for TMS accuracy

Hypothesis 1_b is not supported either. Apart from the fact that early team membership change did not significantly decrease TMS accuracy compared to no team membership change, teams in the early turnover condition did not have significantly less accurate TMSs compared to the late turnover group, β = -0.08, t(22) = 0.66, p = .51, r = 14. Even though not significant, the difference in group means for the early and late turnover condition is in the opposite direction of what was predicted.

Finally, late team membership change did not significantly decrease TMS accuracy compared to the control group, β = 0.05, t(22) = 0.26, p = .80, r = .05. Moreover, late turnover did not significantly increase TMS accuracy compared to early turnover either, β = 0.08 and t(22) = -0.66, p = .51, r = .14. Hence, no support was found for Hypothesis 1_c. Altogether, the results do not support Hypothesis 1.

4.6.2 Hypothesis 2

Hypothesis 2 states that turnover is negatively related to team TMS sharedness, and that teams that faced partial team membership change before the midpoint of their existence will have a more shared TMS than teams that faced team membership changes after the midpoint of their lifetime. To test for this hypothesis an ANCOVA was ran with team's *familiarity with the task* and *TMS sharedness after practice* as covariates. The use of this parametric test was justified since the effect of the independent interaction term was not significant, F(3,18) = 1.17, p = .35, and the assumption of homogeneity of variance was met as well, L(2,23) = 1.14, p = .26.

The covariate *familiarity with the task* was positively, but not significantly so, related to TMS sharedness, β = 0.03, F(1,21) = 0.18, p = .68, r = .09, partial η^2 = .01. The second covariate included in the analysis, *TMS sharedness after practice*, was positively and significantly related to TMS sharedness measured after performing the task, β = 0.59, F(1,21) = 10.03, p = .00, r = .57, partial η^2 = .32. This means that teams that had a more shared TMS after practicing the task also had a more shared TMS after performing the task, Further, the effect of timing of turnover on team TMS sharedness after performance was still not significant, $F(2,21) = 1.93$, $p = .17$, partial $\eta^2 = .15$. However, the p-value for the ANCOVA ($p = .17$) has improved compared to that of ANOVA ($p = .33$). This indicates that the effect of timing of turnover on TMS sharedness is more significant when the effect of the team's familiarity with the task and TMS sharedness after practicing on TMS sharedness are controlled for. Yet, the effect is still insignificant.

Pairwise comparisons were used to check whether the differences in TMS sharedness between groups (see Table 11), adjusted for the effect of the two covariates, are significant or not. First, undergoing early turnover does not significantly decrease team TMS sharedness compared to the control group ($\beta = -0.04$, $t(21) = 0.59$, $p = .56$, $r = .13$) and teams that faced late turnover have insignificantly higher scores for team TMS sharedness compared to the control group, $\beta = 0.05$, $t(21) = 0.74$, $p = .47$, $r = .16$. These results do not support Hypothesis 2_a, since the results were not significant and, in the case of the difference between the control and late turnover conditions, in the opposite direction from what was hypothesized.

TMS Sharedness		
Group Mean:	Unadjusted	Adjusted
Control	0.50	0.54
Early	0.52	0.50
Late	0.59	0.59

Table 11: Group means for TMS sharedness

Moreover, no support was found for Hypothesis 2_b either, since early team membership change did not significantly decrease TMS sharedness compared to no team membership change, and these teams had less shared TMSs compared to teams that underwent late turnover, $\beta = -0.09$, $t(21) = 1.96$, $p = .06$, $r = .39$. Yet, this difference was only marginally significant and in the opposite direction of what was predicted. Therefore, Hypothesis 2_b is rejected altogether.

Furthermore, as the findings above already indicate, no support was found for Hypothesis 2_c either. In specific, late team membership change did not significantly decrease TMS sharedness compared to the control condition ($\beta = -0.05$, $t(21) = -0.74$, $p = .47$, $r = .16$) and did significantly, albeit only marginally, increase TMS sharedness compared to early turnover ($\beta = 0.09$, $t(21) = -1.96$, $p = .06$, $r = .39$). Overall, no support was found for

Hypothesis 2 since the relationships found were either not significant or in the opposite direction of what was hypothesized.

Since this study is based on a rather small sample one has to be careful in terms of the decision one makes regarding the number of covariates to include in the ANCOVAs. This because every covariate included in the model decreases its degrees of freedom, which are already rather limited. In cases like this one might consider making use of a trimmed model, excluding covariates that were found to have an insignificant effect on the dependent variable in earlier statistical tests. Therefore, another ANCOVA was run in testing for Hypothesis 2, which included one covariate (*TMS sharedness after practice*) instead of two.

Testing for ANCOVA's assumptions showed that the effect of the independent interaction term was not significant, $F(2,20) = 0.61$, $p = .55$, and the assumption of homogeneity of regression slopes was thus not broken. Moreover, the assumption of homogeneity of variance was not violated for this analysis either, $L(2,23) = 1.52$, $p = .24$.

The test results show that the covariate, *TMS sharedness after practice* is positively, and significantly, related to TMS sharedness, $\beta = 0.61$, $F(1,22) = 12.47$, $p = .00$, $r = .60$, partial $\eta^2 = 0.36$. However, after controlling for the effect of *TMS sharedness after practice*, the effect of timing of turnover on team TMS sharedness was still insignificant, $F(2,21) = 1.91$, $p = .17$, partial $\eta^2 = .15$.

TMS Sharedness		
Group Mean:	**Unadjusted**	**Adjusted (trimmed)**
Control	0.50	0.55
Early	0.52	0.50
Late	0.59	0.59

Table 12: Group means for TMS sharedness (trimmed model)

Further, planned contrasts reveal whether the differences in TMS sharedness between treatments are significant or not, after the effect of the covariate is controlled for (the adjusted means are shown in Table 12). First, early turnover did not significantly decrease TMS sharedness compared to the control group, $\beta = -0.05$, $t(22) = -0.76$, $p = .45$, $r = .16$. In addition, teams that faced late turnover do not have significantly higher scores for team TMS sharedness than stable teams, $\beta = 0.04$, $t(22) = 0.63$, $p = .54$, $r = .13$. These results do not support Hypothesis 2_a, since the results are not significant. In addition, in the case of the difference between the control and late turnover conditions, the relationship found is in the opposite direction of what was hypothesized.

No support was found for Hypothesis 2_b either. Apart from the fact that early team membership change did not significantly decrease TMS sharedness compared to the control condition, these teams have significantly, even though only marginally, less shared TMSs compared to teams that face late turnover, $\beta = -0.09$, $t(22) = 1.95$, $p = .06$, $r = .38$. Therefore, Hypothesis 2_b is rejected altogether since the hypothesized relationships are not significant or in the opposite direction of what was predicted.

Furthermore, besides the fact that late turnover did not significantly increase TMS sharedness compared to the control condition ($\beta = 0.04$, $p = 0.63$), it was only slightly significantly different in terms of its' TMS sharedness scores compared to the early turnover condition ($\beta = 0.09$, $p = .06$). Hence, no support was found for Hypothesis 2_c either. Taken together, the results of this trimmed model do not support Hypothesis 2 since the differences found were either insignificant or showed a different trend than was hypothesized.

4.6.3 Hypothesis 3

Hypothesis 3 dealt with three measures of team performance; i) time taken till completion, ii) the number of mistakes made in the assembly task and, iii) the number parts that were not used. For each of these performance measures a separate ANCOVA was ran. Together, these analyses test for the hypothesized relationships between timing of turnover and team performance.

i) Time till Completion

Hypothesis 3 states that intact teams will take the least time to complete the task, while teams that face early turnover will take more time than intact teams to perform the task but less time than teams that faced late turnover. Additionally, teams that faced late turnover are thus postulated to take the most time for completing their task.

To test for this hypothesis an ANCOVA was ran with team's *familiarity with the task* as a covariate. It should be noted though that the effect of the independent interaction term was significant, $F(2,20) = 9.84$, $p = .01$. Furthermore, the Levene's test revealed that the variance in *time till completion* was significantly different between groups, $L(2,23) = 95.52$, $p = .00$. In other words, the homogeneity of regression slopes and homogeneity of variance assumptions were violated. This is something to keep in mind when interpreting the results of this analysis.

After controlling for the effect of team's familiarity with the task, the effect of timing of turnover on team time till completion is still significant, $F(2,22) = 6.62$, $p = .00$, partial $\eta^2 = .38$. The covariate, team's familiarity with the task, is negatively but not significantly related to time taken till completion, $\beta = -0.60$, $F(1,22) = 1.29$, $p = .27$, $r = .23$, partial $\eta^2 = .05$. This negative relationship means that the more familiar a team is with electronic assembly tasks, the less time they need to accomplish the task. However, as mentioned, this relationship was not proven to be significant.

Time till Completion		
Group Mean:	Unadjusted	Adjusted
Control	12.98	13.13
Early	15.00	15.03
Late	14.77	14.67

Table 13: Group means 'Time till Completion'

Planned contrast reveal that the group means in terms of the time taken to complete the task, depicted in Table 13 were significantly different. More specifically, teams in the control condition take significantly less time to complete the task compared to teams undergoing early or late turnover , $\beta = -1.89$, $t(22) = -3.64$, $p = .00$, $r = .61$ and $\beta = -1.54$, $t(22) = -2.73$, $p = .01$, $r = .50$ respectively. These results do support Hypothesis 3_a with respect to the time taken till completion.

Moreover, partial support was found for Hypothesis 3_b, since early team membership change did, as mentioned before, significantly increase the time teams took to accomplish the assembly task compared to teams who remained intact ($\beta = 1.89$, $p = .00$). However, teams that underwent early team membership change were not outperforming teams that faced team membership later in their lifetime. In fact, they took longer to accomplish the task. Yet, this difference was not significant, $\beta = -0.35$, $t(22) = -0.91$, $p = .38$, $r = .19$.

Furthermore, from these findings one can deduce that late team membership change did significantly increase the time teams took compared to not having alteration in team composition ($\beta = 1.54$, $p = .01$). Additionally, late turnover did not significantly decrease the time needed to accomplish the task compared to early turnover ($\beta = -0.91$, $p = .38$). Therefore, only partial support was found for Hypothesis 3_c in terms of its predictions related to time.

Overall, partial support for Hypothesis 3 was found. Next, the hypothesis concerning the number of mistakes made is examined by means of an ANCOVA.

ii) Number of Mistakes

It is hypothesized that intact teams will make the least number of mistakes, while teams that faced early turnover will make more mistakes than intact, but less mistakes than teams that faced late turnover. Additionally, teams that faced late turnover are predicted to make the most mistakes in performing the assembly task.

To test for this hypothesis an ANCOVA was ran with team's *familiarity with the task* as a covariate. Both the homogeneity of regression slopes and homogeneity of variance assumptions were not breached by the data, $F(2,20) = 0.42$, $p = .66$ and $L(2,23) = 0.19$, $p = .83$. Further, the results reveal that the covariate, team's familiarity with the task, was negatively but not significantly related the number of mistakes a team made, $\beta = -2.55$, $F(1,22) = 2.87$, $p = .10$, $r = .34$, partial $\eta^2 = .11$. The overall effect of timing of turnover on the number of mistakes made was still insignificant after controlling for the effect of team's familiarity with the task, $F(2,22) = 1.71$, $p = .20$, partial $\eta^2 = .13$.

Table 14 shows the group means before and after controlling for the effect of *familiarity with electronic assembly tasks*. Next, it is analyzed whether these differences between groups in terms of their number of mistakes made are significant or not. First, intact teams make slightly significantly less mistakes compared to teams that faced early turnover, $\beta = 2.72$, $t(22) = 1.83$, $p = .08$, $r = .36$. However, intact teams did not significantly outperform teams that went through late turnover, $\beta = 1.91$, $t(22) = 1.18$, $p = .25$, $r = .24$. Hence, Hypothesis 3_a with respect to the number of mistakes made is only partially supported.

No. of Mistakes		
Group Mean:	Unadjusted	Adjusted
Control	5.25	5.90
Early	8.50	8.61
Late	8.20	7.80

Table 14: Group means for number of mistakes made

Likewise, partial support was found for Hypothesis 3_b. In specific, early team membership change did significantly increase the number of mistakes teams make compared to teams who remained intact (β = 2.72, p = .08). This difference between the two groups was only marginally significant however. Then again, teams that underwent early turnover made more mistakes compared to teams that faced team membership change after the midpoint of their existence. (β = -0.81, t(22) = -0.81, p = .48, r = .17). Yet, this difference was not significant. Besides, apart from being insignificant, this relationship was contradictory to what was predicted; more mistakes rather than less compared to the late turnover condition. In summary, only partial and marginal support was found for Hypothesis 3_b in terms of the number of mistakes teams made.

Further, like one can deduce from the findings discussed above already, no support was found for Hypothesis 3_c in terms of its predictions related the number of mistakes made. On the one hand, late team membership change did not significantly increase mistakes made compared to the control group (β= 1.91, p = .25). Moreover, late turnover did not significantly decrease the number of mistakes made compared to early turnover (β= -0.81, p = .48). Hence, the relationships found in testing for Hypothesis 3_c were not significant and, in the case of the difference between the control and late condition, in the opposite direction of what was predicted. On the whole, these results related to the *number of mistakes teams made* provide only partial support for Hypothesis 3.

iii) Number of Missing Parts

It is hypothesized that intact teams will have the least amount of parts missing after they have completed the task, while teams that face partial team membership change before the midpoint of their existence will have more missing parts than intact teams but less than teams that faced turnover after the midpoint of their team's lifetime. Furthermore, teams that faced partial team membership change after the midpoint of their existence are predicted to have the highest number of missing parts after performing the assembly task.

To test for this hypothesis an ANCOVA was ran with team's *familiarity with the task* and their *experience working together* as covariates. The homogeneity of regression slopes was breached by the data of this analysis, F(3,18) = 4.55, p = .01, while the homogeneity of variance assumptions was not, L(2,23) = 0.27, p = .76. This violation of one of ANCOVA's assumptions is something to keep in mind when interpreting the results of this analysis.

First, the results of this analysis reveal that the team's *familiarity with the task* was negatively, but not significantly related the number parts missing, β = -1.54, F(1,21) = 0.86, p = .36, r = .20, partial η^2 = .04. The team's familiarity in terms of their *experience working* *together*, on the other hand, was found to be positively and significantly related to the number of missing parts, $\beta = 2.44$, $F(1,21) = 4.69$, $p = .04$, $r = .43$, partial $\eta^2 = .18$. That is to say, teams in which team members were more familiar with working with each other did have significantly more parts missing in their telephone assembly. This is a remarkable and possibly a somewhat counterintuitive finding though. Finding a rational or explanation for this phenomenon is beyond the scope of this study however.

Moreover, the analysis shows that, even after controlling for the effect of the two covariates, the effect of the experiment manipulation on the number of parts missing was insignificant, $F(2,21) = 0.18$, $p = .84$, partial $\eta^2 = .02$.

No. of Missing Parts		
Group Mean:	**Unadjusted**	**Adjusted**
Control	3.75	4.03
Early	4.67	4.89
Late	4.80	4.42

Table 15: Group means for number of missing parts

The pairwise comparisons find no support for Hypothesis 3 with respect to the number of missing parts. First, control groups did not significantly have less parts missing compared to teams that underwent team membership change before or after the midpoint of their existence ($\beta = 0.85$, $t(21) = 0.53$, $p = .60$, $r = .11$ and $\beta = 0.39$, $t(21) = 0.22$, $p = .83$, $r = .05$ respectively). In other words, the group means of the early and late turnover conditions, depicted in Table 15, were not significantly different from the control group. Taken together, these results do not support Hypothesis 3_a regarding the number of parts missing in the assembled telephone.

Second, apart from the finding that early team membership change did not significantly increase the number of missing parts compared to the control group ($\beta = 0.85$, $p = .85$), it did not have significantly more parts missing compared to teams that faced late turnover, $\beta = -0.47$, $t(21) = 0.39$, $p = .70$, $r = .08$. Apart from being insignificant, the latter relationship was in the opposite direction of what was predicted; the early turnover condition had more missing parts rather than less compared to the late turnover condition. In summary, no support was found for Hypothesis 3_b either.

Further, no support was found for Hypothesis 3_c, something that can be deduced from the previous discussion of the results too. In specific, the pairwise comparisons reveal that late turnover did not significantly increase the number of parts missing compared to intact teams (β = 0.39, p = .83) and not significantly decrease the number of parts missing compared to the early turnover condition (β = -0.47, p = .70).

As mentioned earlier, in this study one has to be rather cautious in terms of the decision one makes with respect to the number of covariates that are included in the ANCOVAs, since this has a limiting effect on the degrees of freedom which are rather small already. Therefore, another ANCOVA was run for Hypothesis 3 with respect to the number of missing part. This time only one covariate, the team's familiarity in terms of their *experience working together*, was included in the analysis

For this analysis, the effect of the independent interaction term was found to be significant, $F(2,20) = 5.79$, $p = .01$, while the assumption of homogeneity of variance was not violated, $L(2,23) = 0.04$, $p = .96$. Like mentioned before, this violation of one of ANCOVA's assumptions is something to keep in mind when interpreting the results of the analysis.

The results reveal that the familiarity in terms of *experience working together* was positively and significantly related to the number of missing parts ($\beta = 2.70$, $F(1,22) = 6.19$, $p = .02$, $r = .47$, partial $\eta^2 = .22$). Like for the previous analysis, the effect of timing of turnover on the number of parts missing was found to be insignificant after controlling for the effect of the covariate, $F(2,22) = 0.31$, $p = .74$, partial $\eta^2 = .02$.

No. of Missing Parts		
Group Mean:	**Unadjusted**	**Adjusted (trimmed)**
Control	3.75	3.63
Early	4.67	4.84
Late	4.80	4.64

Table 16: Group means for number of missing parts (trimmed model)

The results for the associated planned contrasts show no support for Hypothesis 3 with respect to the number of parts missing in the assembled telephone. First, teams in the control condition did not significantly have less parts missing than teams that underwent team membership change before or after their midpoint of existence ($\beta = 1.20$, $t(22) = 0.78$, $p = .45$, $r = .16$ and $\beta = 1.01$, $t(22) = 0.64$, $p = .53$, $r = .13$ respectively). In other words, the group means of the early and late turnover condition, depicted in Table 16, were not significantly different from the control group. Therefore, Hypothesis 3_a was not supported regarding its predictions with respect to the number of missing parts.

Second, concerning Hypothesis 3_b, we saw that early team membership change did not significantly increase the number of parts missing in the assembled telephone compared to teams who remained intact (β = -1.20, p = .45). In addition, teams belonging to the early turnover condition did not significantly have more parts missing than teams that faced team membership change after the midpoint of their existence (β = 0.19, t(22) = 0.17, p = .87, r = .04). Apart from being insignificant, this relationship was in the opposite direction of what was predicted (i.e. more missing parts rather than less).

Finally, from these findings we can deduce that no support was found for Hypothesis 3_c either and this is also what the pairwise comparisons reveal. The differences between groups were insignificant and, in the case of late compared to early turnover, in the opposite direction of what was predicted. That is to say, late team membership change did not significantly increase the number of missing parts compared to intact teams (β = -1.01, p = .53), and did not significantly decrease the number of missing parts compared to early turnover either (β = -0.19, p = .87).

4.6.4 Hypothesis 4

Hypotheses 4_a and 4_b stated that TMS sharedness and TMS accuracy mediate the relationship between timing of turnover and team performance (i.e. time till completion, the number of mistakes made and the number of missing parts). TMS sharedness and TMS accuracy would qualify as mediating variables when they meet the following conditions (Baron & Kenny, 1986):

(1) Timing of turnover (i.e. the independent variable) is significantly related to TMS accuracy and/or TMS sharedness (i.e. the presumed mediators),

(2) TMS sharedness and TMS accuracy should be significantly related to team performance (i.e. the dependent variable),

(3) When the relationship between the independent variable and the mediator and the relationship between the mediator and the dependent variable are controlled for, the previously significant relation between timing of turnover and team performance should become insignificant.

The mediating function of TMS accuracy and TMS sharedness can be confirmed only when these three conditions are met. However, the findings for Hypothesis 1 and Hypothesis 2 reveal that the first condition is not met already. That is to say, timing of turnover is neither significantly related to TMS accuracy nor to TMS sharedness. Therefore, no mediating effect of TMS accuracy and TMS sharedness can be tested for, and Hypothesis 4 is thus not supported.

4.7 Summary of Findings

To sum up, the results of the analyses conducted to test for this study's hypotheses are summarized below and an overview of the results is provided by Table 17 and Figure 6. First, the study's findings show that timing of turnover had no significant effect on TMS accuracy. Teams in the control group did indeed have the most accurate views. Further, as opposed to what was expected, teams in the late turnover condition had more accurate TMSs than teams in the early turnover condition. Yet, none of these differences in TMS accuracy between groups were significant. Therefore, Hypothesis 1 was rejected altogether.

Second, the effect of timing of turnover on TMS sharedness was not significant. Moreover, contradictory to what was expected, teams in the late turnover condition had the most shared TMSs, followed by the control group and the early turnover group, in this respective order. Only the difference in TMS sharedness between the early and late turnover condition was (marginally) significant ($p = .06$), but the difference was opposite of what was expected though (L > E instead of the expected E > L). Taken together, the findings do not support Hypothesis 2.

Third, Hypothesis 3 dealt with three measures of team performance. Overall, the experiment's treatment had a significant effect on the time taken till completion. However, only partial support was found for the hypothesized differences between groups. Teams in the control group were indeed significantly faster than teams in the early turnover and late turnover condition. Hence, Hypothesis 3a is supported regarding its predictions about time till completion. Yet, teams in the late turnover condition outperformed teams in the early turnover condition, but this difference between groups was not significant. Therefore, the results do not support Hypothesis 3b and 3c with respect to time taken till completion.

Further, the overall effect of timing of turnover on the number of mistakes made was not significant. Moreover, even though teams in the control group did indeed make the least mistakes, the difference between groups was not significant compared to the later turnover group and only marginally significant compared to the early turnover group. Hence, Hypothesis 3a regarding the differences between groups in the number of mistakes made is only partially supported. Further, teams in the late turnover condition outperformed teams in the early turnover condition, but this difference in the number of mistakes they made was not significant. Therefore, the results do not support Hypothesis 3b and 3c with respect to this second measure of team performance.

		TMS Accuracy	TMS Sharedness	TMS Sharedness (trimmed model)	Time till Completion	No. of Mistakes	No. of Missing Parts	No. of Missing Parts (trimmed model)
		β (p-value)	β (p-value)	β (p-value)	β (p-value)	β (p-value)	β (p-value)	β (p-value)
Covariates:	Familiarity Task	0.14 (.41)	0.03 (.68)		-0.60 (.27)	-2.55 (.10)	-1.54 (.37)	
	TMS Sharedness after Practice		0.59 (.00)	0.61 (.00)				
	Familiarity Working Together						2.44 (.04)	2.70 (.02)
Pairwise Comparisons:	Control vs. Early	0.13 (.44)	0.04 (.56)	0.05 (.45)	1.90 (.00)	-2.72(.08)	-0.85 (.60)	-1.20 (.45)
	Control vs. Late	0.05 (.80)	-0.05 (.47)	-0.04 (.54)	1.54 (.01)	-1.91 (.25)	-0.39 (.83)	-1.01 (.53)
	Early vs. Late	-0.08 (.51)	-0.09 (.06)	-0.09 (.06)	-0.35 (.38)	0.81 (.48)	0.47 (.70)	0.19 (.87)
Adjusted Means:	Control	3.41	0.54	0.55	13.13	5.90	4.03	3.63
	Early	3.29	0.50	0.50	15.03	8.61	4.89	4.84
	Late	3.37	0.59	0.59	14.67	7.80	4.43	4.64
Effect Treatment: (F-value)		0.42 (.66)	1.93 (.17)	1.91 (.17)	6.62 (.01)	1.71 (.20)	0.18 (.84)	0.31 (.74)
Interactions: (F-value)	IV*Fam.Task	0.01 (.99)			9.84 (.01)	0.42 (.66)		
	IV*Fam.Task*TMS_1		1.17 (.35)					
	IV*TMS_1			0.61 (.55)				
	IV*Fam.Task*Fam.Work						4.55 (.01)	
	IV*Fam.Work							5.79 (.01)

Table 17: Results of the ANCOVAs

Additionally, the results of the analyses show that the experiment's treatment (i.e. timing of turnover) did not significant affect the number of parts missing. Moreover, differences between groups were not significant. Hence, even though teams in the control condition did indeed have the least missing parts, Hypothesis 3a had to be rejected since the differences with the other two groups were not significant. Further, Hypothesis 3b and Hypothesis 3c were also rejected, because, apart from the insignificant differences between groups, teams in the late turnover condition did better than teams in the early turnover group in terms of the number of parts missing (i.e. opposed to what was expected). Hence, Hypothesis 3 was rejected altogether, regarding its predictions about the number of parts missing.

Finally, TMS sharedness and TMS accuracy did not mediate the relationship between timing of turnover and team performance. Since these two variables were not significantly related to timing of turnover themselves, they could impossibly be mediating variables in this relationship between the independent variable and the team performance measures. Hence, Hypothesis 4 was not supported.

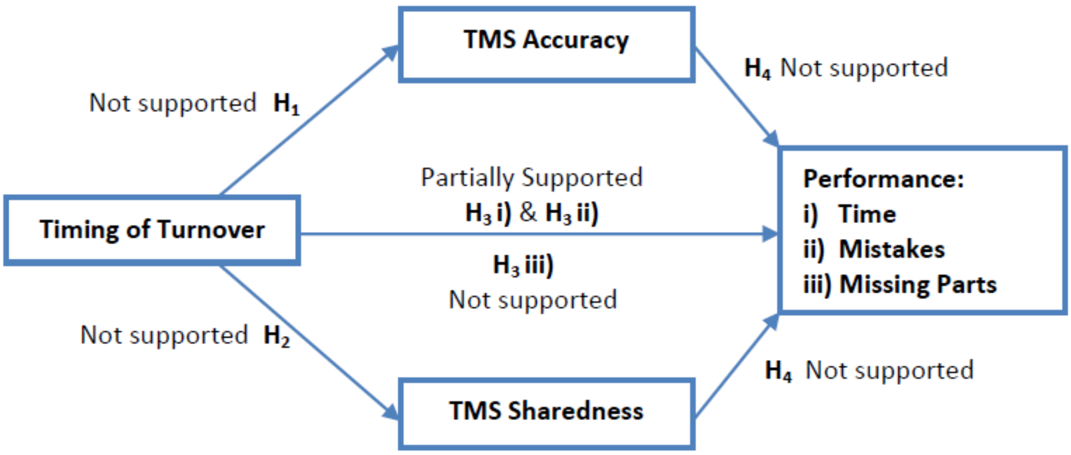

Figure 6: Support found for the hypotheses

5. Discussion and Conclusion

5.1 Discussion

Organizations are increasingly relying on work-teams rather than on single individuals. The majority of previous research on teams tends to treat teams as stable. However, most teams ultimately do not have stable membership and face partial turnover at some point. These changes in membership could pose difficulties to a team as, amongst others, members will have to adjust their operations to the changed distribution of task-relevant knowledge (Moreland, 1999). This adjustment is likely to be necessary because a newcomer will hardly ever be a perfect substitute to the team member that left. Research can increase our understanding of the effect that the turnover has on teams and whether teams are actually capable of making the required amendments. Moreover, Choi & Thompson (2005) argue that the timing of membership change is likely to affect group functioning, and that this issue should be addressed by future research.

The current research responds to this request for further research, by addressing exactly this aspect of organizational teams that previous research has often ignored; the timing of team membership change. It explored the temporal issues of team membership change and TMS development. Thereby, this thesis contributes to existing research. That is to say, the purpose of this study was to find out whether the timing of membership change matters and to gain insight in the relation between timing of membership change and team transactive memory systems' (TMSs) accuracy and sharedness. It sought an answer to the question whether intact teams and teams that experienced partial membership change at different points in time differ in terms of their TMS accuracy, TMS sharedness, and performance.

The hypotheses developed to answer these questions were examined in the previous chapter and the findings are summarized in Table 17 and Figure 6. This chapter continues with a discussion of these findings. Afterwards, the limitations of this study are being discussed. Finally, the paper end with a discussion of the findings' implications and a conclusion.

5.1.1 TMS Accuracy

First, this study found that membership change did not significantly decrease team TMS accuracy. Moreover, the timing of membership change was not significantly related to the accuracy of teams' understanding of who knows what either. Since there were no significant differences in TMS accuracy between the treatment groups, this study's proposition that membership change and its timing help predict team TMS accuracy is disputed.

This finding may imply that oldtimers and newcomers of teams that experienced team membership change during their 'Phase 1' and 'Phase 2' were equally efficient in adapting their transactive memory structure to the changed situation (i.e. the changed distribution of task-relevant knowledge in their team). If this is indeed the case, this contradicts the theory of the punctuated-equilibrium model (Gersick, 1988) that teams that are considered to be in a period of inertia are incapable of adapting to new insights that challenge their existing behavioural patterns and assumptions. Moreover, this study's findings do not seem to correspond with previous studies that show that teams develop more accurate TMSs through repeated interpersonal interactions (Austin, 2003).

5.1.2 TMS Sharedness

The second hypothesis explored the relationship between timing of turnover and team TMS sharedness. This hypothesis was not supported. However, the difference in TMS sharedness between teams that experienced membership change <u>before</u> the teams 'midpoint' and teams that experienced membership change <u>after</u> the teams 'midpoint' was marginally significant. This suggests that timing of team membership change does help predict the degree to which members have shared representations of the team's TMS. Yet, the relation found was in the opposite direction of what was expected.

Teams that experienced team membership change after their 'midpoint' have more shared representations of their transactive memory than teams that experienced membership change before their 'midpoint'. This relationship was unexpected because of two reasons. First, previous research suggests that team TMS sharedness may grow over time as members interact with one another and refine their understanding of each member's skills (Austin, 2003; Moreland, 1999). This implies that teams develop an increasingly shared understanding of their team members' competencies as they spent more time together, but the current study suggests otherwise. Teams that experienced membership change after their 'midpoint' have spent less time interacting with the newcomer and yet their TMS sharedness is higher than that of teams that faced 'early' membership change. Second, based on the punctuated-equilibrium model (Robbins & Judge, 2007) one would also expect that team members who spent more time together (i.e. are together since before the teams midpoint/transition phase) develop more shared TMSs. Team members that experienced the 'transition phase' together have, according to the punctuated-equilibrium model, had more opportunity to adjust their individual mental models and develop shared mental models than team members that are fairly new to working in their current composition and did not go through this phase together. Hence, the latter kind of teams is expected to have less shared TMSs. Yet, as mentioned, this current study does not provide evidence for this reasoning.

The fact that timing of team membership change is positively related to team TMS sharedness may imply that members of teams that experienced team membership change closer to the deadline tend to be more efficient in adapting and communicating their (changed) representation of the team's transactive memory structure. Yet, this explanation would argue against everything previous research on TMS sharedness has found thus far. However, the findings may also suggest that the experimental design, sampling method and/or measurement scales used for this study might not have been appropriate for studying the precise influence timing of membership change has on team TMS development.

5.1.3 Team Performance

The third hypothesis explored the relation between timing of team membership change and team performance. In specific, it dealt with the relationship between membership change and three measures of team performance; i) time taken, ii) number of mistakes, and iii) number of missing parts. First, the hypothesis regarding time till completion was partially supported, suggesting that turnover does help predict the time needed to perform a task, but that the timing of change does not lead to significant differences between groups. In other words, the findings show that stable teams are substantially faster in completing their task than teams that experience membership change, but that teams that experience membership change either before or after the 'midpoint' of their lifetime do not perform differently.

The predicted relations between timing of turnover and team performance were based on previous research suggesting that a well-developed TMS is characterized by, amongst others, high levels of sharedness and accuracy (Austin, 2003) and associated with better team performance (e.g. Lewis, 2004; Moreland & Myaskovsky, 2000; Lewis et al., 2007; Moreland, 1999; Austin, 2003 after Libby et al., 1985 and Littlepage & Silbiger, 1992). Based on these studies and the punctuated-equilibrium model it was expected that treatment groups would differ in terms of their TMS accuracy and TMS sharedness and hence in terms of their team performance as well. Particularly since accuracy and sharedness of TMSs are said to be two important predictors of group performance (Edwards, Day, Bell & Bell, 2006), by enabling the correct use of available knowledge resources and reducing coordination mistakes (Austin, 2003). However, we saw that timing of turnover does not help predict team TMS accuracy and TMS sharedness. Therefore, there must be an alternative explanation for the relation found between team membership change and time till completion.

Second, the hypothesis with respect to the relation between timing of turnover and the number of mistakes teams make was partially supported. The findings suggest that the overall effect of the timing of membership change is not significant, because teams that experience membership change either before or after the 'midpoint' of their lifetime do not perform differently. Yet, teams that experienced membership change before the midpoint of their existence make more mistakes than stable teams. This may suggest that teams in the 'early' change condition have more difficulties coordination their work than stable teams, while teams in the 'late' turnover condition do not face these problems. Teams that experience 'late' membership change may not experience these coordination difficulties because they might be close to finishing the task already at the time that they experience turnover. Oldtimers may choose to complete the task in a similar manner as they did before their team's composition was altered; sticking to their original division of responsibilities.

Third, timing of team membership change was not related to the performance measure *number of missing parts,* nor were there any differences between the treatment conditions. Hence, the performance measure 'number of missing parts' may be assumed to be immune to the effects of change in team composition on team processes.

Finally, as opposed to Hirst's (2009) conclusions, timing of membership change was not found to be critical to team performance. Short-tenured and longer-tenured teams did not differ significantly in their performance. Interestingly, only one of the measures of team performance is significantly affected by the treatment of this study's experiment; the time teams take to complete their task. This may suggest that the timing of membership change has an effect on a certain aspects/processes within teams which are in turn differently related to the different measures of team performance. What these aspects/processes could be is something that remains unclear in this study. We can be sure however that it is neither TMS accuracy nor TMS sharedness since these were not found to be related to timing of membership change. Future research might like to follow up on this.

5.2 Limitations

This study also has its limitations that have to be taken into account when interpeting the results and which future research could try to work its way around. First, this study was conducted in a laboratory setting, making use of a non-random sampling strategy, rather than in a real-life organization with existing teams. This limits the extent to which the results can be generalized to different contexts (Bordens & Abbot, 2008), especially because undergraduate students do not necessarily interact and perform like existing work teams would (Sears, 1986). However, due to time constraints a laboratory study where one has control over the treatment the participants receive was preferred over a longitudinal field study.

Moreover, for this study teams had to perform a task within a very short time and the participants formed an ad-hoc team in a single experimental session that lasted for 1.5 hours only. Therefore, the possibility exists that the study's results suffer from a Type 1 temporal error (McGrath, Arrow, Gruenfeld, Hollingshead & O'Connor, 1993 as cited in Harrison et al., 2003), meaning that the results found in this study may not be the same for observations of teams that are longer-lived or perform their task in a more natural setting. It would therefore be interesting for future research to study the effect that timing of membership change has on real-life teams that exist over a longer period of time. Then, one will be able to see whether this study's findings hold up in a more natural setting or not.

Another limitation related to time is the fact that some teams worked faster than others. Therefore team's individual 'midpoint' of its existence was not necessarily exactly halfway the experiment's performance phase (i.e. at 7.5 minutes). Hence, it is possible that treatments performed in the experiment (i.e. the membership changes) did not actually take place during the phase that it was intended to take place in (i.e. in Phase 1 or Phase 2) but in another phase or during the transition phase.

Regarding the sample size, the study could have benefitted from a larger and more equally distributed sample. The number of teams included in this study (N=26) and their uneven distribution among the treatment conditions (N=4, N=12, and N=10), complicates matters in conducting analyses on the data. In more detail, among others, the degrees of freedom are limited for small sample sizes like this and it becomes more difficult to find significant relationships. The small sample size is partly a result of participants not showing up and as a consequence some of the planned sessions had to be cancelled. Hence, it would be beneficial to future research if issues like this are circumvented, for example, by making sure that there are enough ‘back-up’ participants and an equal number of sessions conducted for each condition of the experiment.

Finally, regarding the measurement of team TMS accuracy and TMS sharedness, the study relied on subjective, self and other-ratings of the participants. However, the fact that team members seem to have an accurate and shared understanding of who knows what does not necessarily imply that they actually act upon this insight too. Therefore, to measure a team TMS sharedness and accuracy future research could use more objective measures (e.g. scored observations) in addition to the self-report measures. This way researchers can measure to what extent to the team members’ understanding is congruent with their actual actions.

5.3 Implications for Future Research

This study suggests that the timing of team membership change does not affect team TMS accuracy or sharedness. However, as pointed out in the discussion of this study’s limitations, further studies on this topic might be useful, making use of larger sample sizes and carried out in more natural settings. In addition, researchers may want to use different theories to base the exact timing of membership change on a different theory than the punctuated-equilibrium model. Research using different timings of team membership change than this study might also come up with different findings than this study did. The fact that the timing was not relevant in this research does not necessarily imply that timing of membership change is not relevant at all in relation to team TMSs. Yet, in order to be able to make a more informed decision on when to change team members exactly during the study, a more complete understanding of the precise TMS development process might be needed first.

Moreover, as discussed in previous section on this study’s limitations, research could benefit from more objective measures of TMS accuracy and TMS sharedness. This way, research could measure to what extent to the team members’ understanding is congruent with their actual actions. One way in which this can be achieved is by analysing the video footage of the experiment. By analysing the team processes like the communication an interaction patterns and the socialization process of newcomers, researchers could compare the subjective measure of TMS to the observations of actual team processes and performance.

Further, if researchers happen to be interested in replicating the current study, one might want to consider including a team measure of personality. This measure could focus on the average score for different personality traits and on the extent to which personality is heterogeneous or homogeneous within the team. This particularly since previous research on personality indicates that certain types of personality heterogeneity may affect team performance (Mohammed & Angel, 2003). Hence, future research might like to control for this potential effect of personality, by including a composite and more comprehensive measure of personality in the analysis.

Moreover, the current study did not use a composite measure of team composition with regards to the gender of the participants. Future research could look investigate the role of gender further as regarding to the composition of the team before and after team membership change. Replacing a male in an all-male team by a female may have a different effect on the team's processes (e.g. interaction processes and the division of labour) than replacing that male by another male. These differences could have an effect on the team's transactive processes and memory structure.

Finally, future research could extend the current research by looking at different kinds of newcomers. In this experiment team membership change was characterized as a transfer (i.e. team members were replaced by newcomer who recently belonged to a similar team). However, there exist different kinds of newcomers, like those who do not have task-relevant experience and replace a former member or those who are not expected to stay with the team for a long time (i.e. visitors). Levine and Choi (2004) argue that different kinds of newcomers may differ in their ability to influence the team's shared cognition. Hence, it would be interesting to see whether and how these different types of newcomers affect the relationship between (the timing of) membership change and team TMSs and, subsequently, team performance.

5.4 Conclusion

The purpose of this study was to explore the extent to which timing of team membership change affect a team's transactive memory system in terms of the accuracy and sharedness of team members' perceptions of the knowledge and skill distribution within the team.

Moreover, the study sought an answer as to how the timing of team membership change was related to team performance. The study tried to provide answers to these questions by means of conducting an experiment in which ad-hoc and short-lived teams performed a telephone assembly task, a task that previous research on team TMSs used as well, which makes interpreting the results easier.

This study suggests that the timing of membership change does not matter when it comes to the accuracy and sharedness of teams' transactive memory structure. The timing of turnover does however affect the time teams need to complete a task and the number of mistakes they make. In specific, regarding time needed to complete the task; teams that do not experience membership change perform their task quicker than teams that experience membership change either before or after the midpoint of the team's life-span. Second, regarding mistakes made by the team, teams that no not experience membership change make fewer mistakes than teams that experience membership change before the midpoint of their existence. Since these differences in team performance cannot be attributed to differential levels of accuracy and sharedness of team TMSs, there must be an alternative explanation for them. Future research might be able to provide us with a likely alternative explanation.

Although there are still many unanswered questions regarding the development process of TMSs and their relation to membership changes awaiting an answer, this research helps to enhance our understanding of TMSs, the effect of timing of membership change and, thus, the effects that organizations' reorganization and replacement policies may have on team processes and outcomes.

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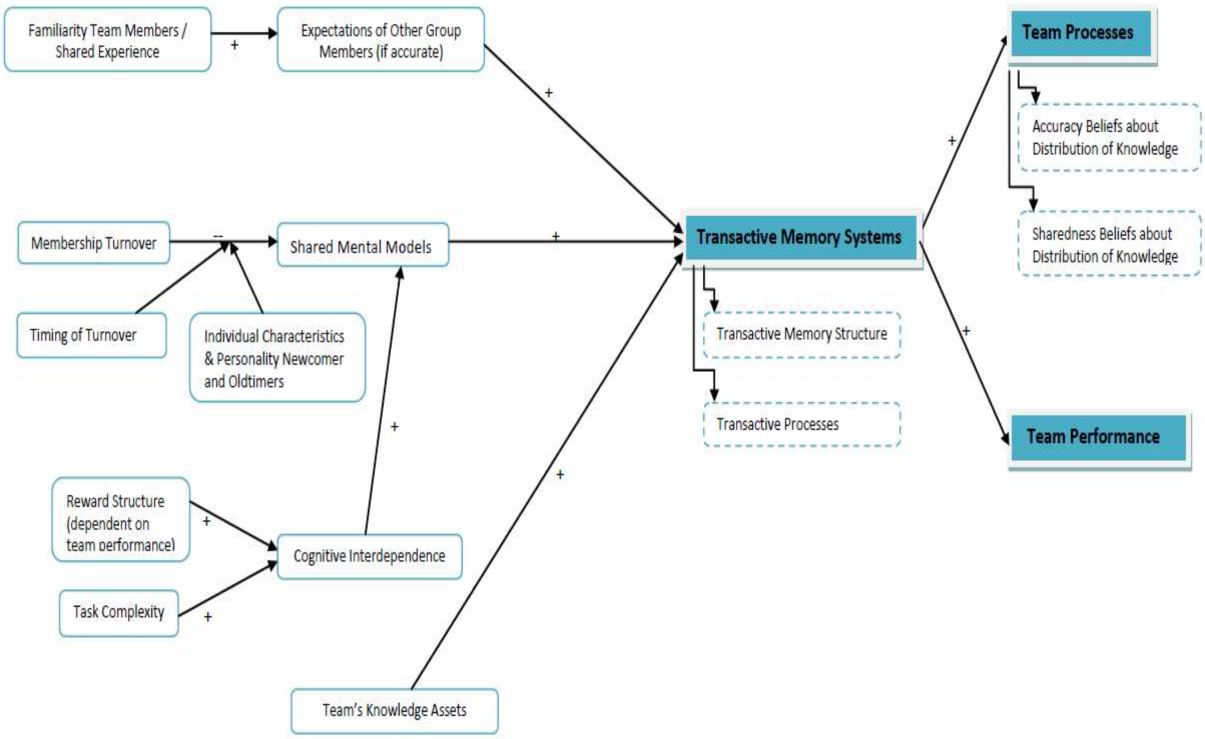
Appendices

Appendix 1: Conceptual Model



Appendix 2: Information Letter

Information Letter

Version date: April 16th, 2010
Study Name: Team telephone assembly task
Researcher: Liefke van Ooijen
Sponsor: School of Business and Economics, Maastricht University.

Purpose of the Research: The current study examines the relationship between team training and performance in teams consisting of three members.

What You Will Be Asked to Do in the Research: During this research you will be asked to assemble an electronic kit. You will first receive an introduction presentation and training exercise and then you will engage in a performance session. Moreover, during the experiment session you will be asked to fill in some questionnaires related to the task.

Risks and Discomforts: No risks or discomfort from your participation in the research are expected to occur.

Benefits of the Research and Benefits to You: You will receive a 10 Euro VVV-voucher for participating in this study. Additionally, a financial reward will be awarded to the best performers. 20 Euro will be rewarded to each member of the best performing team.

Voluntary Participation: Your participation in the study is completely voluntary and you may choose to withdraw from the study at any time. In the event you withdraw from the study, all collected data associated to your participation will be immediately destroyed.

Withdrawal from the Study: You can withdraw from the study at any time, for any reason, if you so decide. In case you decide to withdraw from the study you will not receive the 10 Euro VVV-voucher.

Confidentiality: All information you supply during the research will be held in confidence and your name/student ID will not appear in any report or publication of the research. The data will be collected by means of questionnaires and video recording during the performance session and will then be loaded into electronic spreadsheets. Your data will be safely stored in a locked facility and on a password protected computer and only research staff will have access to this information. The electronic spreadsheet data will be archived on a password protected computer. Confidentiality will be provided to the fullest extent possible.

Questions About the Research? If you have questions about the research in general or about your role in the study, please feel free to contact Liefke van Ooijen by e-mail (l.vanooijen@student.maastrichtuniversity.nl).

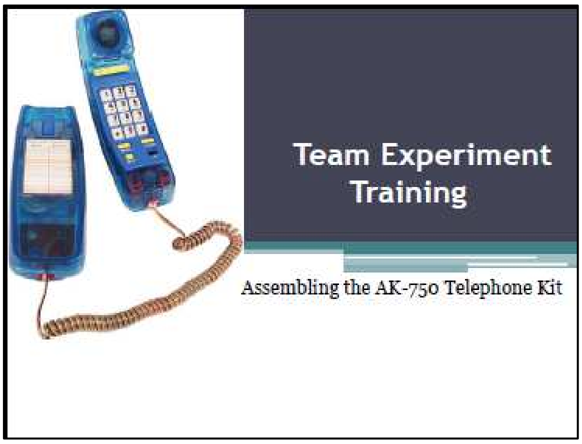
Informed Consent and Signatures:

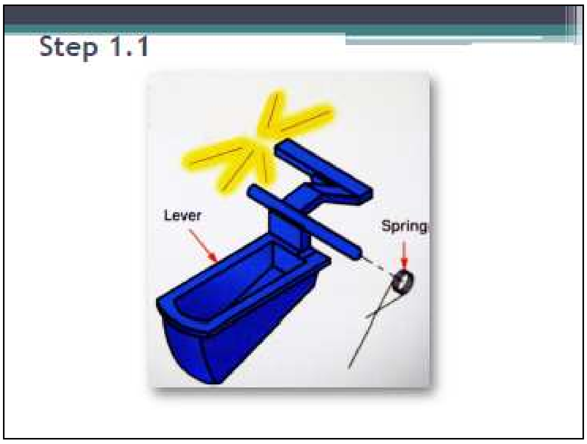
I____, consent to participate in the study *Team telephone assembly task* conducted by *Liefke van Ooijen.* I have understood the nature of this project and wish to participate. My signature below indicates my consent.

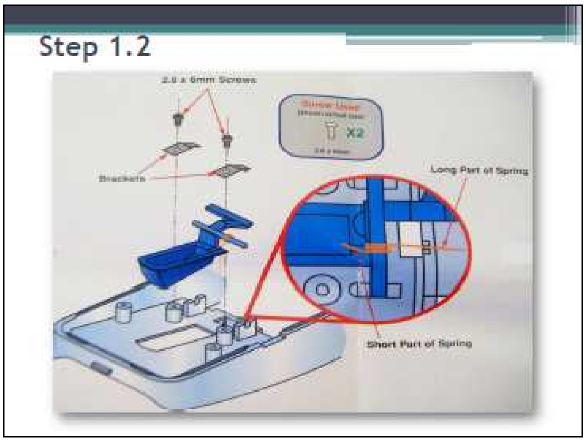
Signature____________________ **Date**________________
Participant

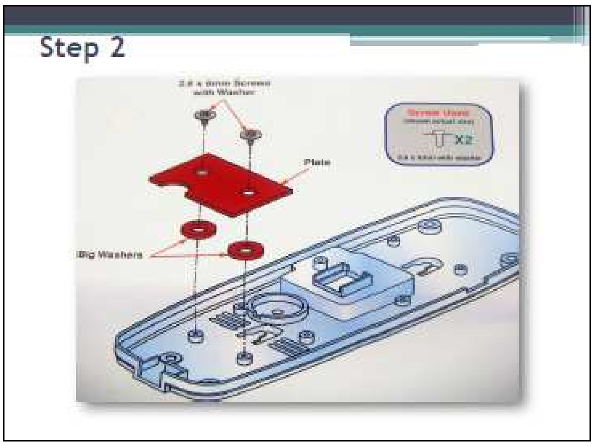
Signature____________________ **Date**________________
Experimenter

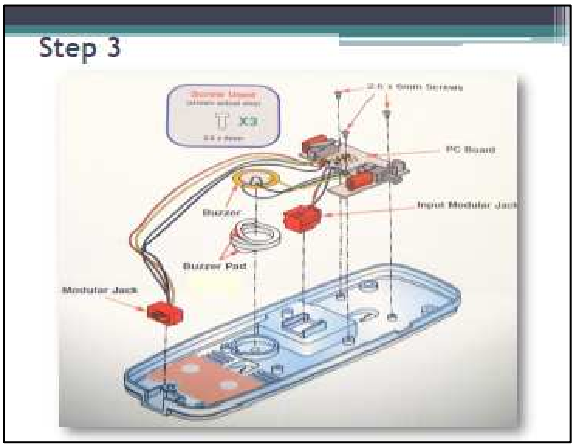
Appendix 3: PowerPoint-Presentation Training





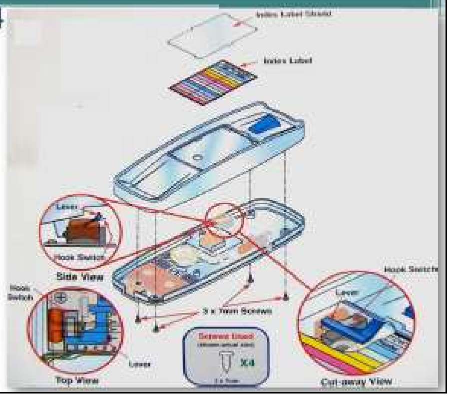




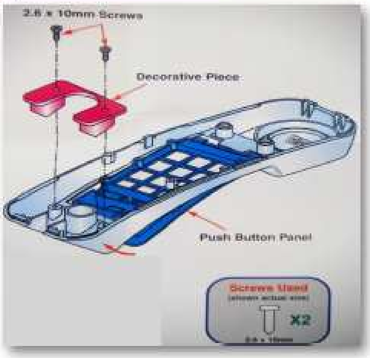


Step 5-9 Handset Assembly

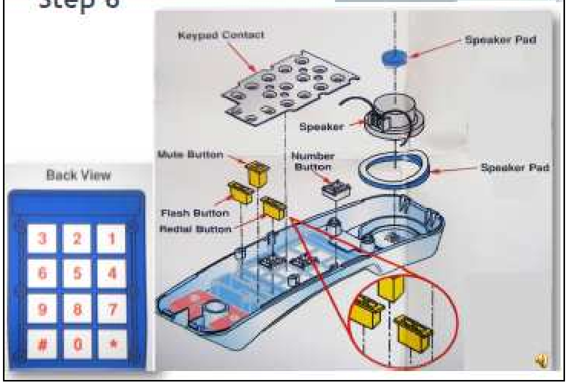
Step 4



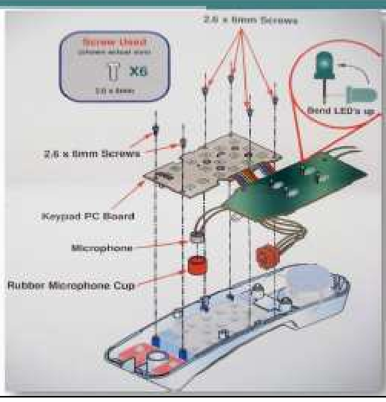
Step 5



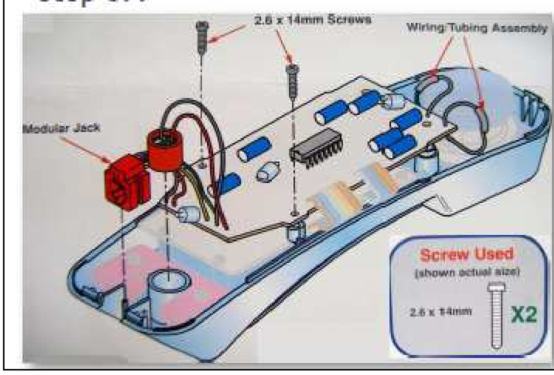
Step 6



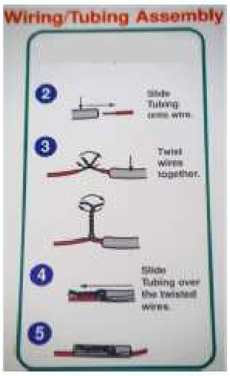
Step 7



Step 8.1

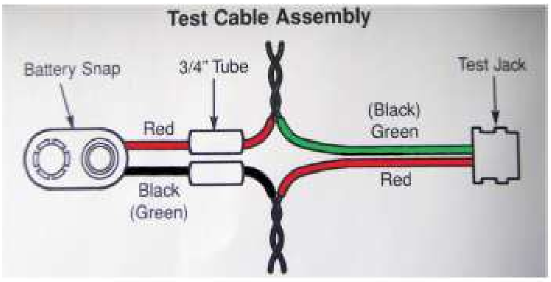


Step 8.2

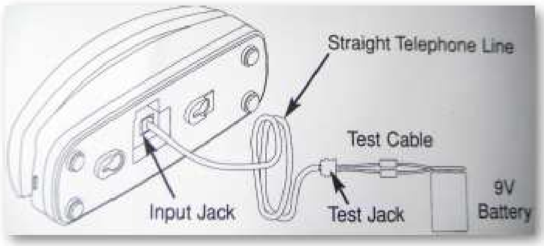


Step 9

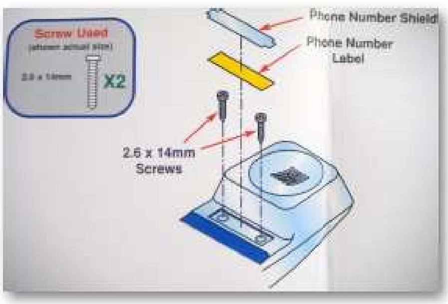
Transmit-Receive Test (1)



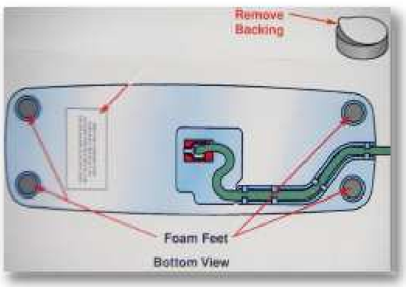
Transmit-Receive Test (2)



Step 10.1



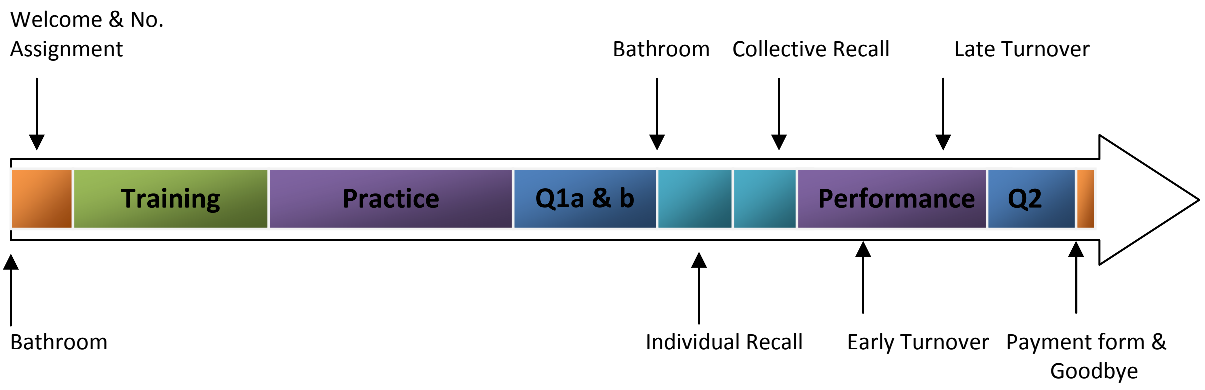
Step 10.2



Appendix 4: Protocol

Protocol: Timing of Team Membership Turnover & TMSs

Timeline experiment sessions

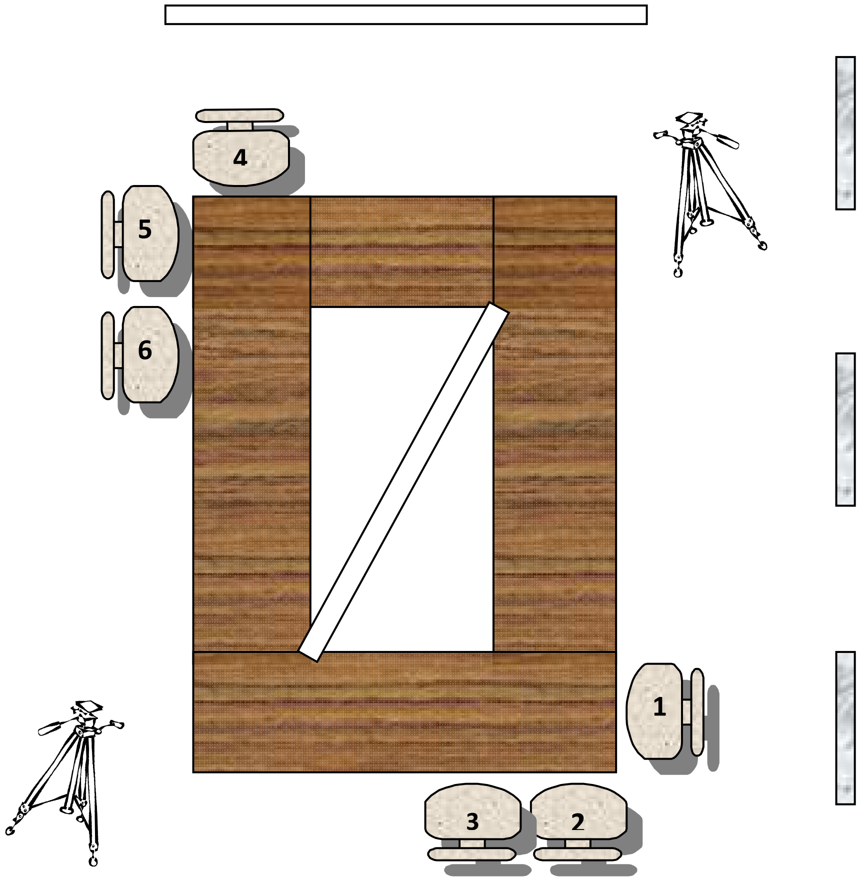


Materials: 4 rewriteable DVDs of 30min(Plus RW Sony), 2 tripods, 2 movable walls, pens, number cards & stickers, questionnaires, recall forms, 9 telephones & boxes for telephones, 2 camera's , 5 screwdrivers, laptop for making backup of videotape, informed consent form, payment forms, 2 egg-timers, 5x 9V batteries, extension cord, presenter, Scotch tape, paper to cover windows, 'do not enter sheet, USB-stick with presentation, and print of the students that are scheduled in for the day.

Definitions:

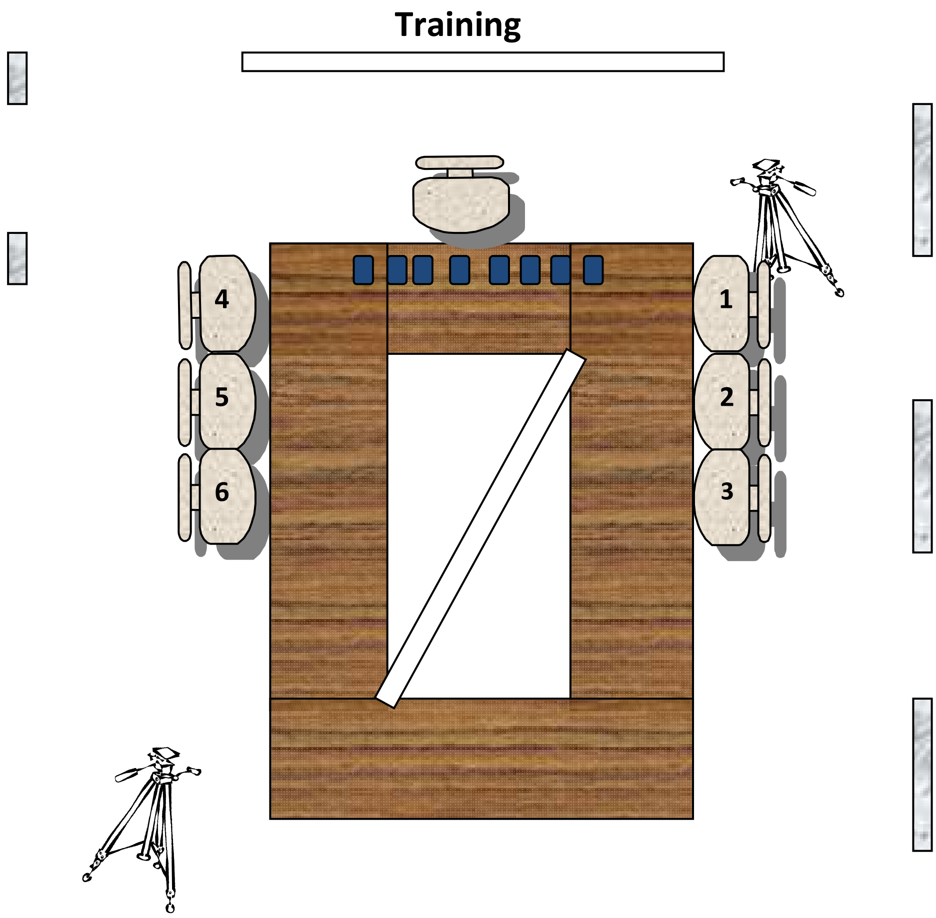
No. assignment	Part of a session where each participant draws one of the six cards (numbered 1-6), which is the participant number they get allocated to for the experiment session.
Q1 a&b	Questionnaires 1a & 1b
Q2	Questionnaire 2
Session	One complete experiment session (numbered 1 till 21)
Training	Part of a session where participants are trained in assembling the telephone kit; by means of slides showing the parts, spoken text describing the steps, and the experimenter showing how the assembly should be done
Practice	Part of a session where participants are given time to practice the assembly of the telephone kit
Individual recall	Part of a session where participants are asked to recall how the assembly of the telephone kit should be done and write this down on the individual recall sheet
Collective recall	Part of a session where teams are asked to recall how the assembly of the telephone kit should be done and write this down on the collective recall sheet
Performance	Part of a session where teams have to assembly the telephone kit as a team; their performance will be evaluated afterwards by the experimenter
Early turnover	Treatment: switching team members 2 & 5 between groups after 5 minutes of 'performance'
Late turnover	Treatment: switching team members 2&5 between groups after 10 minutes of 'performance'
Team X	The team consisting of participant numbers 1,2,3
Team Y	The team consisting of participant numbers 4,5,6

Preparation



- Print sheet of participants that are scheduled for the day.
- Get room key from reception
- Get 2 camera's, stopwatch, 2 tripods, telephone kits, screwdrivers, boxes, pens, number cards, badges, 9V batteries from Secretariat's office.
- Check mailbox for new registrations.
- Bring required questionnaires, recall sheets, consent forms, DVDs, VVV-vouchers and payment forms along from home.
- Get movable wall
- Hang up paper on door; There is a study taking place in this room, please do not enter!
- Set up planning table (in room XXX) with questionnaires, forms, recall sheets, paper, pens, badges, number cards, stopwatch set at 15 minutes and 9 unassembled telephone kits (8 unassembled in a white box, 1 in blue box).
- Cover the windows with paper

- Put the chairs already at the tables. Indicate on table where each person should sit (indicate position of 1, 2, 3, 4, 5, 6 on table). Put an information letter and an informed consent form on the tables, one for each participant.
- Open the training presentation on the computer in the room, turn the beamer on, and put presenter-stick in USB-portal computer.
- Sort items for each step ...put them in a row step 1→10 , to perform training
- Prepare step 1,2,5,6



- **Before participants enter the room check name, ID, and give them the opportunity to visit the bathroom.**

Welcome to this experiment. Before we start, I would like each of you to draw a card from the stack I have here. Each card has a number written on it. Please take the seat that corresponds to the number on your card. After each of you has taken his/her seat we will continue with this experiment.

- **Guide participants to their seats after they have drawn a number card from the stack.**

During this experiment session you will be assembling a telephone kit in teams of three. Person 1, 2 & 3 form a team and Person 4, 5, 6 form a team as well. Each of you will be rewarded with 10 Euros for participation. Additionally, the team members of the best performing team in this experiment will be rewarded a bonus of 20 Euros each.

...

Before we continue with this experiment I would like you to read the information letter and fill in the informed consent form.

- **Take the pens & informed consent form from each participant and continue with the instructions.**

As I told before, during this experiment you will assemble a telephone kit in teams of three. First, you receive a training telling you how you should assemble the telephone kit. The training consists of slides showing the parts and steps required for the assembly, a spoken text describing the different steps and the experimenter (me) showing how the telephone kit is to be assembled...

Now you will first receive the training. Do not talk to each other during the presentation and do not take notes. During this training no asking of questions is allowed. After the training is over you will be given time to practice the telephone assembly as a team.

Please listen and watch the instructions carefully, since this will be the only time you will see how the telephone assembly should be performed.

  - **Open the presentation on the computer and start presentation. (set egg-timer at 20 min)**
  - **Perform each step of the assembly after the slide has been shown. Do this for the 10 subsequent steps & transmit-receive test.**

	Step 1 till 4: Cradle Assembly
Step 1	**Assembling the front-part of the cradle case**
Step 1.1	▪ *Put the 'spring' in place, by sliding it around the right side of the 'lever'.*
Step 1.2 **Prepared in advance**	▪ *Attach the 'lever' to the 'cradle case', using the two brackets and two '2.6x6mm screws'. ... Make sure the spring is put in the right position: short part of the spring pointing towards the lever and the long part pointing towards the top of the cradle case.*
Step 2	**Assembling the back-part of the cradle case**
Prepared in advance	▪ *Put the two 'big washers' in place, by putting them around the two circles close to the bottom of the cradle case. ...* ▪ *Then, put the 'plate' on top of the 2 big washers ... and attach the 'plate' to the 'cradle case' by making use of two '2.6x6mm screws with washer'.*

Step 3	**Attaching the PC board to the back-part of the cradle case**
	▪ *Attach the 'PC board' to the cradle case, using three '2.6x6mm screws'. ...The wires should be 'facing' the bottom part of the cradle case. ...* ▪ *Then, put the 'input modular jack' in the square-figured hole in the centre of the cradle case. ... Make sure that the big hole in the 'input modular jack' is facing the back of the cradle case.* ▪ *Attach the 'buzzer pad' to the cradle case by sticking it to the large circle. ... Then, attach the 'buzzer' to the 'buzzer pad'. ...* ▪ *Finally, put the 'modular jack' in place, at the bottom of the cradle case. The side with the hole should be facing the exterior of the cradle, while the side with the wires is on the inside.*
Step 4	**Putting the cradle case together**
	▪ *Place the 'index label' on the cradle case (front)... and, then, put the 'index label shield' over it. This may take a couple of attempts to attach the two. ...* ▪ *Attach the two parts of the cradle case, by placing the front part on the back part. This may take a couple of attempts .... When attaching the two, make sure that the 'lever' is placed <u>above</u> the 'hook switch'. ...* ▪ *Once the two parts of the cradle case are put together, affix them by making use of four '3x7mm screws', ... two at the top of the cradle case (back) and two at the bottom part of the cradle case (back)*
	Step 5 till 9: Handset Assembly
Step 5	**Attaching the decorative piece and push button panel to the front-part of the handset case**
Prepared in advance	▪ *Attach the 'decorative piece' to the bottom part of the 'handset case', using two '2.6x10mm screws'. ...* ▪ *Then, put the 'push button panel' in place by pushing it up and snapping it into position.*
Step 6	**Installing the buttons and speaker**

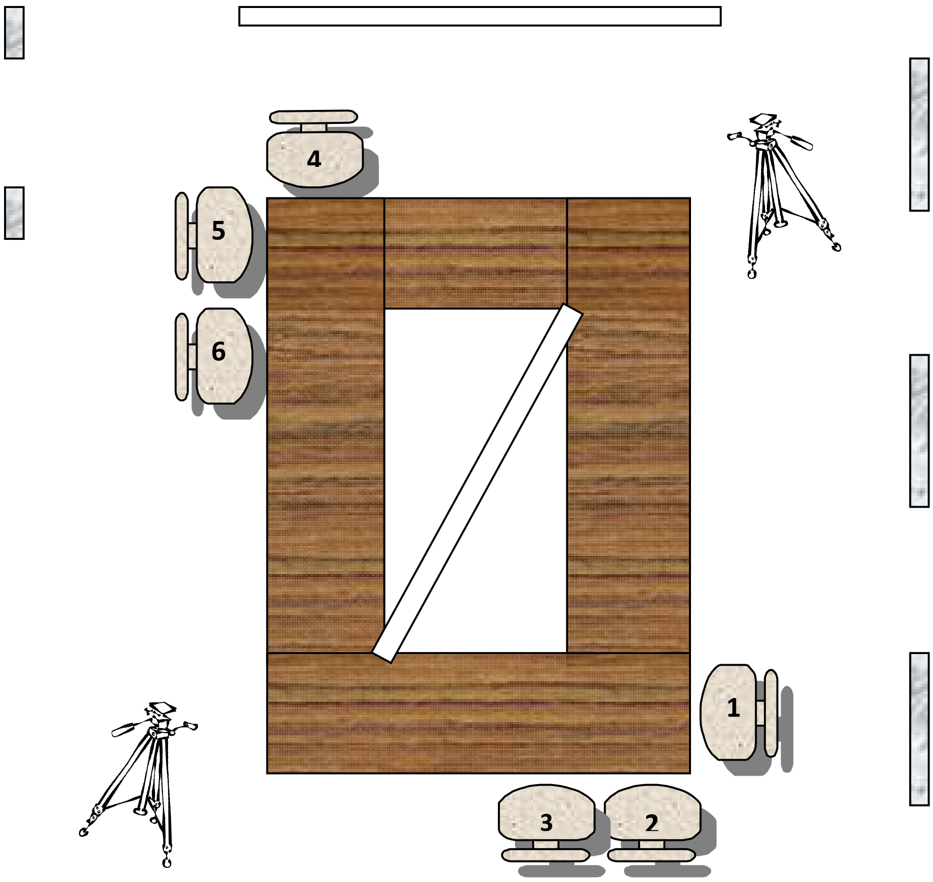
Push button panel prepared in advance	▪ *Put the 'keypad, mute, flash and redial buttons' in their right position into the 'push button panel'. ....*
	    o *Make sure that the angle of the 'flash, redial and mute buttons' are in the same direction. ...*
	    o *The picture on the left side of the slide can be used as a guide when installing the 'number buttons'. ...*
	▪ *Once the buttons are in place, put the 'keypad contact' on top of the buttons ...*
	▪ Install the speaker by ... (1) *putting the large 'speaker pad' into the speaker hole in the handset case ... (2) sticking the 'speaker' to the 'speaker pad' ... and (3) sticking the small 'speaker pad' on top of the 'speaker'. ... Make sure that the wires of the speaker are 'facing' the bottom part of the handset case.*

Step 7	**Installing the keypad PC board**
	▪ *Attach the bottom part of the 'keypad PC board' to the 'handset case', making use of six '2.6x6mm screws'. ...* ▪ *Then, carefully push the 'microphone' into the 'rubber microphone cup'...* ▪ *Now, turn the top part of the 'keypad PC board' around, ... such way that the LED's go through the four holes in the centre of the bottom part of the 'keypad*

	PC board'.
Step 8	**Fixing the keypad PC board, microphone, wires and modular jack**
Step 8.1	▪ Fix the 'keypad PC board' to the 'handset case', using two '2.6x14mm screws'. ... ▪ *Then, put the microphone in place, putting it in the circle-shaped hole on the bottom part of the 'handset case'. ...* ▪ *Put the 'modular jack' in place, by clicking it into the bottom part of the 'handset case'. ... Make sure that the side of the 'modular jack' with the big hole, where you can put cable, is facing the exterior of the 'handset case'. ...* ▪ *Connect the wires of the 'keypad PC board' to the wires of the 'speaker'. How you do this is shown on the next slide ...*
Step 8.2	▪ *To connect the wires...* o *Slide the tubing onto the wire, ...* o *Twist the wires together, ...* o *And, finally, Slide the tubing over the twisted wires.*
Step 9	**Putting the handset together & connecting it to the cradle case**
	▪ *Attach the two parts of the handset, by placing the cover on the back part. ... When snapping the cover on, start from the back. ... Attaching the two pieces may take a couple of attempts.* ▪ *Connect the handset and cradle case by means of the 'coiled cord'. ...*
Transmit-Receive Test	
(1) **Prepared in advance**	**Test cable assembly** ▪ *Twist the wires of the 'battery snap' and 'test jack' cable together and slide the tubing over the twisted wires.*
(2) **Connection to 9V battery prepared in advance.**	**Transmit-receive test** ▪ *Connect the telephone to the test cable with the 9Volts battery connected to it using the telephone line cable.* ▪ *Then,* *1. Put your ear to the speaker and depress and release the hook switch. You should hear a click* ***If you do not hear a click, then:*** ▪ ***Check the assembly of the test cable*** ▪ ***Check whether the lever is located over the hook switch (step 4)*** ▪ ***Check whether the wires from the PC board are properly connected to the speaker*** *2. Put your ear to the speaker and gently tap or scratch the case where the microphone is located. You should hear the tapping on the speaker* *3. As you are tapping, push and hold the mute button down. You should hear the tapping sound* ***If the 2nd and 3rd test fail, then:*** ▪ ***Check the microphone and speaker wires*** ▪ ***Check whether the mute button is installed correctly.***

	▪ ***Remove the test cable from the telephone line and continue with the assembly, step 10.***
Step 10	**Final assembly: attaching phone number shield & foam feet**
Step 10.1	▪ *Fix the handset, using two '2.6x14mm screws'. ...* ▪ *Then, put the' phone number label' in place ... and put the 'phone number shield' on top of it.*
Step 10.2	▪ *Stick the four' foam feet' to the bottom of the 'cradle'...* *This was the final step of the telephone assembly*

Practice



Now that you have seen how the telephone kit should be assembled, you have the ability to practice the telephone kit assembly for 20 minutes within your team. Due to the complexity of the task and the limited time you have it is best to divide the task within your team.

During the practice trial each team may ask 2 questions in total. When you have a question, please raise your hand and I will come over to your table to answer the question.

No note taking or communication between the teams is not allowed. Only communicate with your own team mates.

Your performance as a team in this practice trial will not be part of your final score. Once I tell you so, you may open the box and start practicing the telephone assembly. Please do not throw the parts out of the box, the parts might break off.

- **Give each team a box with an unassembled telephone kit, cards of steps, and a screwdriver and set the egg-timer at 20min.**

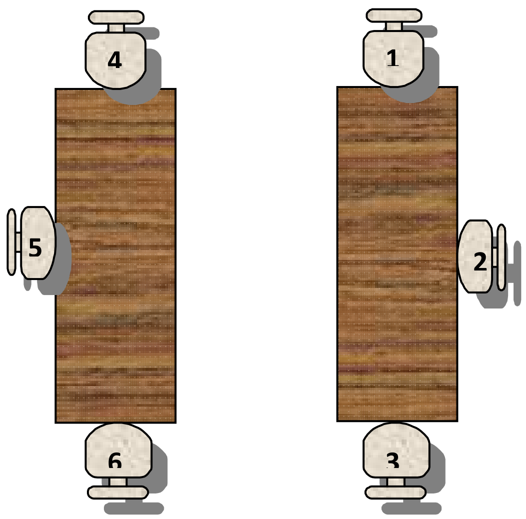
You may now start the assembly.

- **During the practice trial walk around to see whether the teams have questions and come over to their table in case they have questions.**
- **Warn the teams 5 minutes before the end of the practice session that they only have 5 minutes left.**

You have 5 minutes left to finish the telephone assembly

- **After 20 min:** *Your practice time is over. Please stop working on the telephone and put down the screwdriver and parts you may still have in your hands. Please do not talk and wait for further instructions.*
- **After the time is over, collect the telephones, screwdriver and give each participant Q1a&b, definitions of skills/knowledge areas and a pen.**
- **Make sure that team members of team X & team Y sit like …(see below)… at the table so they cannot look at each other's questionnaire and progress.**

Please go and sit like this.......



Please fill in questionnaire 1a & 1b rapidly but accurately. You are not allowed to talk to each other during and after filling in the questions. If you are finished, please wait for your team member and the other team. Further instructions will follow.

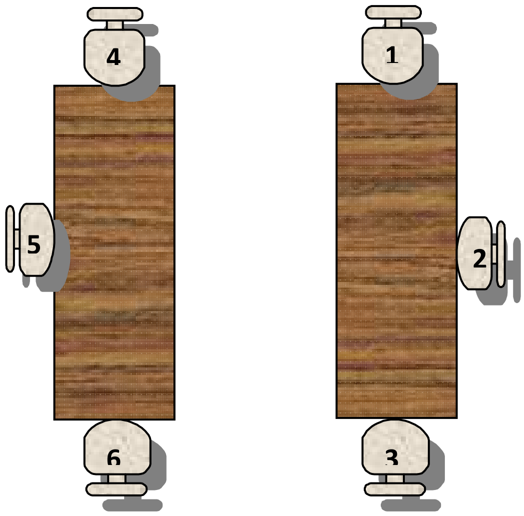
- **While the participants fill in the questionnaires.**
- **Collect Q1a&b and definitions of skills/knowledge areas from each participant once each participant is done. <u>Check whether each of them has completed the questionnaire.</u>**
- **Give participants opportunity to visit bathroom:** *If you would like to visit the bathroom, you may do so now. We will continue afterwards.*

Recall

<u>Individual recall</u>

- **Make sure that team members of team X & team Y sit like …(see below)… at the table so they cannot look at each other's questionnaire and progress.**

Please go and sit like this.......



- **Give each participant an individual recall sheet.**

Each of you will now be given 7 minutes to recall the steps needed to assemble the telephone kit. The telephone assembly consists of 34 separate actions that require different parts/materials. ... Please try to recall these actions and note them down on the recall sheet as accurately as possible. Note that the transmit-receive test is not part of the 10 steps of the telephone assembly.

You are not allowed to talk to each other during and after filling in the questions. If you are finished, please wait for your team members and the other team.

- **Set egg-timer at 7 min.**

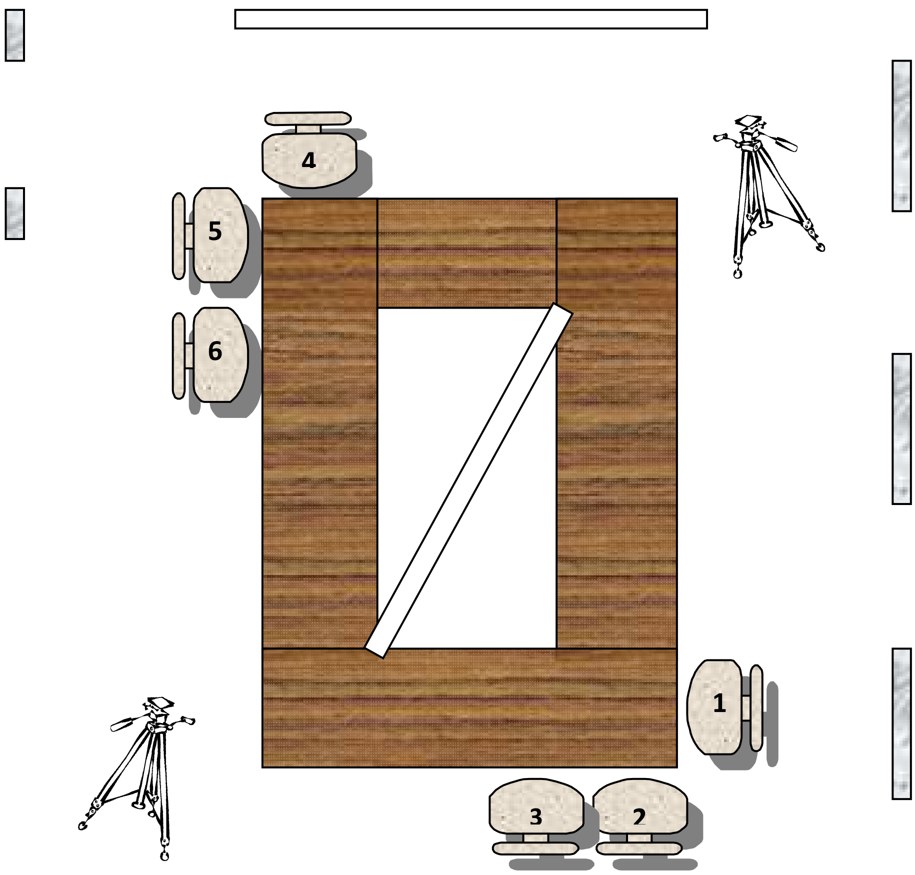
After 7 minutes:

The 7 minutes are over. Please stop working on the recall sheet and put down your pen. Please do not talk and wait for further instructions

- **Collect recall sheet from each participant.**

Collective recall

Now, please go and sit like this.



- **Give each team a collective recall sheet**

Now you will be given 7 minutes to recall the steps needed to assemble the telephone kit with your team. You are not allowed to talk to members of the other team or the experimenter during and after filling in the questions. If you are finished, please wait for the other team.

- **Set egg-timer at 7 min.**

After 7 minutes:

The 7 minutes are over. Please stop working on the recall sheet and put down your pen. Please do not talk and wait for further instructions

- **Collect recall sheet & pens from each team.**

Performance

Please refer to the separate manipulation instructions per manipulation condition:

#1 Control Group condition

#2 Early Team Membership Change condition

#3 Late Team Membership Change condition

- **Pick the respective condition:**

In a moment you will be performing the telephone assembly task. You have now 15 minutes to accomplish the task. In order to be able to finish the assembly within this time, you might want to consider dividing the task between the three of you. Your team performance will be evaluated based on the time till completion, the level of completion and the number of mistakes made.

- **Start the videos.** Press the START/STOP button on the CAMERA screen and make sure it is recording:
- **Give each team an unassembled telephone kit & screwdriver and start the stopwatch and egg-timers (set at 15min)**

Now you can start the assembly

- **the exact procedure during the 'performance' depends upon the condition:**
- **#1**: the teams will be performing the task during the 15 min. No team membership change takes place
- **#2:** the teams will be performing the task during the 15min. After 5 min team membership change will take place. Team members 2 & 5 will be interchanged with each other. From now on: team X will consist of person 1, 5 & 3 and team Y will consist of person 4, 2 & 6.

After 5 minutes:

Sorry to interrupt; due to some unforeseen circumstances it has been decided that the team composition has to be altered. Therefore, person 2 and 5 will have to change teams.

To person 2 & 5:

Please let go of the work you were currently performing and stand up to take your seat at the other team's table. Do this as quickly as possible, because time keeps running. From now on you will be working with the other team.

After they have taken their seat: *please continue….*

- **#3:** the teams will be performing the task during the 15 min. After 10 min team membership change will take place. Team members 2 & 5 will be interchanged with each other. From now on: team X will consist of person 1, 5 & 3 and team Y will consist of person 4, 2 & 6.

  After 10 minutes:

  Sorry to interrupt; due to some unforeseen circumstances it has been decided that the team composition has to be altered. Therefore, person 2 and 5 will have to change teams.

  To person 2 & 5:

  Please let go of the work you were currently performing and stand up to take your seat at the other team's table. Do this as quickly as possible, because time keeps running. From now on you will be working with the other team.

  After they have taken their seat: *please continue….*

While the participants are performing:

- **Make sure that Q2 and the payment forms are ready**

After 12 minutes:

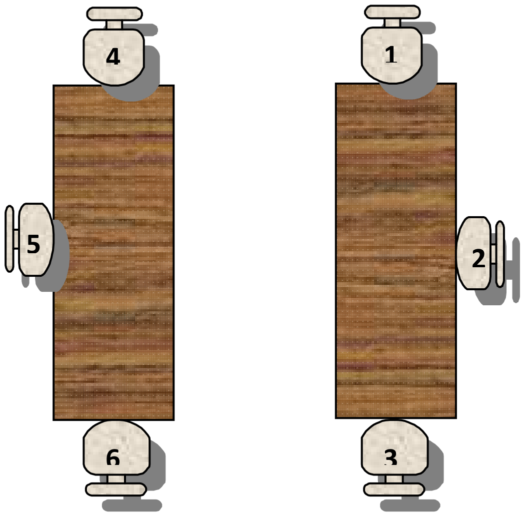
You have 3 minutes left to finish the telephone assembly

After 15 minutes:

Your performance time is over. Please stop working on the telephone and put down the parts/screwdriver you still have in your hands. Please do not talk and wait for further instructions.

- **Stop Camera**
- **Collect telephones, screwdriver & possibly loose parts from each team & put them in the box again.**

- **Make sure that team members of team X & team Y sit like …(see below)… at the table so they cannot look at each other's questionnaire and progress.**



Please go and sit like this...

- **Give each participant their Questionnaire 2, description of skills/knowledge areas & pen**

Please fill in questionnaire 2 rapidly but accurately. You are not allowed to talk to each other during and after filling in the questions. If you are finished, please wait for your team member and the other team.

- **While participants fill in Q2, prepare payment forms for each participant.**

- **Collect questionnaire 2 from each participant. <u>Check whether each of them has completed the questionnaire.</u>**

Closure

Thank you all very much for your participation in this experiment. Please do not talk about the content of the experiment with anybody else because this may have an effect on my data collection and endanger the scientific process. You will receive more information about the research via e-mail. The winning team of the bonus of 20Euros per team member will be contacted by e-mail.

In order to receive your payment, I would like you to fill the following form (reimbursement form).

- **After participant hands in reimbursement form, give VVV-voucher.**

Appendix 5: Questionnaire 1a

Questionnaire 1a

Please answer the following questions

1) First name: ………………………………………….

2) Last name: ………………………………………….

3) Student ID: i………………………………………..

4) Age (yrs): ………………………………………….

5) Gender: ◻ Male ◻ Female

6) Field of study:
- ◻ International Business
- ◻ International Business Economics
- ◻ Infonomics
- ◻ Econometrics
- ◻ Other: …………………………………..

7) Nationality
- ◻ Dutch
- ◻ German
- ◻ Other: …………………………………..

8) Please indicate what you think your knowledge/skill level is with regard to electronics/electronic kit assembly.

a. Based on past experience, I would rate my overall knowledge level of electronics as…

Beginner	Somewhat Knowledgeable	Rather Knowledgeable	Very Knowledgeable	Expert
◻	◻	◻	◻	◻

b. Based on past experience, I would rate my overall skill level with electronic kit assembly as…

Beginner	Somewhat Skilled	Rather Skilled	Very Skilled	Expert
◻	◻	◻	◻	◻

9) **For each skill/area of knowledge listed below, write the number of the team member(s) that you believe is most knowledgeable in that particular skill or area.** (please refer to the list describing the different skills/ areas of knowledge to get an idea of what these skills include)

a. **Mechanical knowledge**	Person 1 / 2 / 3
b. **Handset assembly**	Person 1 / 2 / 3
c. **Cradle assembly**	Person 1 / 2 / 3
d. **Screw driving**	Person 1 / 2 / 3
e. **Organizing/sorting parts**	Person 1 / 2 / 3
f. **Keypad assembly**	Person 1 / 2 / 3
g. **Small parts assembly**	Person 1 / 2 / 3
h. **Other: ....**	Person 1 / 2 / 3

10) **For each skill/area of knowledge, please report the number that corresponds with your evaluation of your ability in that skill/area knowledge.** (please refer to the list describing the different skills/ areas of knowledge to get an idea of what these skills include)

	Very Low 1	Low 2	Average 3	High 4	Very High 5
a. **Mechanical knowledge**	□	□	□	□	□
b. **Handset assembly**	□	□	□	□	□
c. **Cradle assembly**	□	□	□	□	□
d. **Screw driving**	□	□	□	□	□
e. **Organizing/sorting parts**	□	□	□	□	□
f. **Keypad assembly**	□	□	□	□	□
g. **Small parts assembly**	□	□	□	□	□
h. **Other: ....**	□	□	□	□	□

Appendix 6: Questionnaire 1b

Questionnaire 1b **Student ID:** i................

11) **Please use the list below of common human traits to describe yourself as accurately as possible. Describe yourself as you see yourself at the present time, not as you wish to be in the future. Describe yourself as you are generally or typically, as compared with other persons you know of the same sex and roughly the same age.**

Please indicate on the scale below how accurately these traits describe you (the scale runs from **extremely inaccurate** to **extremely accurate**.

	Extremely Inaccurate	Very Inaccurate	Moderately Inaccurate	Slightly Inaccurate	Neither inaccurate nor accurate	Slightly Accurate	Moderately Accurate	Very Accurate	Extremely Accurate
Bashful (shy/easily embarrassed)	□	□	□	□	□	□	□	□	□
Bold (confident/courageous)	□	□	□	□	□	□	□	□	□
Careless	□	□	□	□	□	□	□	□	□
Cold	□	□	□	□	□	□	□	□	□
Complex	□	□	□	□	□	□	□	□	□
Cooperative	□	□	□	□	□	□	□	□	□
Creative	□	□	□	□	□	□	□	□	□
Deep (philosophical)	□	□	□	□	□	□	□	□	□
Disorganized	□	□	□	□	□	□	□	□	□
Efficient	□	□	□	□	□	□	□	□	□
Energetic	□	□	□	□	□	□	□	□	□
Envious	□	□	□	□	□	□	□	□	□
Extraverted	□	□	□	□	□	□	□	□	□
Fretful (anxious/irritated)	□	□	□	□	□	□	□	□	□
Harsh (rough/cruel)	□	□	□	□	□	□	□	□	□
Imaginative	□	□	□	□	□	□	□	□	□
Inefficient	□	□	□	□	□	□	□	□	□
Intellectual	□	□	□	□	□	□	□	□	□
Jealous	□	□	□	□	□	□	□	□	□
Kind	□	□	□	□	□	□	□	□	□
Moody	□	□	□	□	□	□	□	□	□
Organized	□	□	□	□	□	□	□	□	□
Philosophical	□	□	□	□	□	□	□	□	□
Practical	□	□	□	□	□	□	□	□	□
Quiet	□	□	□	□	□	□	□	□	□
Relaxed	□	□	□	□	□	□	□	□	□
Rude	□	□	□	□	□	□	□	□	□
Shy	□	□	□	□	□	□	□	□	□
Sloppy (careless/unsystematic)	□	□	□	□	□	□	□	□	□
Sympathetic	□	□	□	□	□	□	□	□	□

(Questionnaire continues on next page...)

	Extremely Inaccurate	Very Inaccurate	Moderately Inaccurate	Slightly Inaccurate	Neither inaccurate nor accurate	Slightly Accurate	Moderately Accurate	Very Accurate	Extremely Accurate
Systematic	☐	☐	☐	☐	☐	☐	☐	☐	☐
Talkative	☐	☐	☐	☐	☐	☐	☐	☐	☐
Temperamental	☐	☐	☐	☐	☐	☐	☐	☐	☐
Touchy (quick to take offence; oversensitive)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Uncreative	☐	☐	☐	☐	☐	☐	☐	☐	☐
Unenvious	☐	☐	☐	☐	☐	☐	☐	☐	☐
Unintellecutal	☐	☐	☐	☐	☐	☐	☐	☐	☐
Unsympathetic	☐	☐	☐	☐	☐	☐	☐	☐	☐
Warm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Withdrawn	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix 7: Descriptions of the Skills/Knowledge Areas of the Assembly Task

<u>Description of the skills / areas of knowledge</u>

a) Mechanical knowledge	= e.g. connecting the wires, performing the transmit-receive test, attaching cables, etc.
b) Handset assembly	= e.g. performing the assembly of the handset (step 4-9). The handset is the part of the telephone containing the push buttons and the speakers.
c) Cradle assembly	= e.g. performing the assembly of the cradle case (step 1-4). The cradle case is the part of the telephone upon which the handset is positioned.
d) Screwdriving	= e.g. using the screwdriver and putting the screws in the right place.
e) Organizing / sorting parts	= e.g. sorting the different parts needed for the assembly of each step, making sure that all the parts of the telephone kit are used, etc.
f) Keypad assembly	= e.g. putting the buttons in the right place / in the right position.
g) Small parts assembly	= e.g. putting the speaker/ buzzer pads in place, the speaker in the speaker cup, the spring around the lever, etc.
h) Other:	= fill in any other skill / area of knowledge that you think you or one of your team members was knowledgeable in.

Appendix 8: Individual Recall Sheet

Student ID: i................

12) Try to recall how the telephone kit should be assembled. Please use the table below to describe the sequence, actions, and parts required for assembling the telephone kit. (Please note that the transmit-receive test is not part of the 10 steps of the telephone kit assembly)

Step 1	Description
1	
2	
Step 2	
3	
4	
Step 3	
5	
6	
7	
8	
9	
Step 4	
10	
11	
12	
13	
14	
Step 5	
15	
16	
Step 6	
17	
18	
19	
20	
21	
Step 7	
22	
23	
24	
Step 8	
25	
26	
27	
28	
Step 9	
29	
30	
Step 10	
31	
32	
33	
34	

Appendix 9: Questionnaire 2

(Version: Person 2, early turnover condition)

Questionnaire 2 **Student ID:** i..............

Please answer the following questions

14) For each skill/area of knowledge listed below, write the name of the team member(s) that you believe is most knowledgeable in that particular skill or area. (please refer to the list describing the different skills/ areas of knowledge to get an idea of what these skills include)

a.	**Mechanical knowledge**	Person 2 / 4 / 6
b.	**Handset assembly**	Person 2 / 4 / 6
c.	**Cradle assembly**	Person 2 / 4 / 6
d.	**Screw driving**	Person 2 / 4 / 6
e.	**Organizing/sorting parts**	Person 2 / 4 / 6
f.	**Keypad assembly**	Person 2 / 4 / 6
g.	**Small parts assembly**	Person 2 / 4 / 6
h.	**Other: ....**	Person 2 / 4 / 6

15) For each skill/area of knowledge, please report the number that corresponds with your evaluation of your ability in that skill/area knowledge. (please refer to the list describing the different skills/ areas of knowledge to get an idea of what these skills include)

		Very Low 1	Low 2	Average 3	High 4	Very High 5
a.	**Mechanical knowledge**	☐	☐	☐	☐	☐
b.	**Handset assembly**	☐	☐	☐	☐	☐
c.	**Cradle assembly**	☐	☐	☐	☐	☐
d.	**Screw driving**	☐	☐	☐	☐	☐
e.	**Organizing/sorting parts**	☐	☐	☐	☐	☐
f.	**Keypad assembly**	☐	☐	☐	☐	☐
g.	**Small parts assembly**	☐	☐	☐	☐	☐
h.	**Other: ....**	☐	☐	☐	☐	☐

16) Please indicate how often you have worked together with the other team members in the past.

	Not at all	A little	Moderately	Quite a bit	A lot
Former team					
a. Person 1	☐	☐	☐	☐	☐
b. Person 3	☐	☐	☐	☐	☐
Current team					
c. Person 4	☐	☐	☐	☐	☐
d. Person 6	☐	☐	☐	☐	☐

17) How familiar do the other people in your team seem to you?

	Not at all	A little	Moderately	Quite a bit	Very
Former team					
a. Person 1	☐	☐	☐	☐	☐
b. Person 3	☐	☐	☐	☐	☐
Current team					
c. Person 4	☐	☐	☐	☐	☐
d. Person 6	☐	☐	☐	☐	☐

18) Please indicate how much you agree with the following statements.
(1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree)

	1	2	3	4	5
a. During the task performance I felt (time) pressure.	☐	☐	☐	☐	☐
b. During the task performance I felt stressed.	☐	☐	☐	☐	☐

19) Please indicate how much you agree with the following statements.
(1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree)

	1	2	3	4	5
a. I could not accomplish the task without information/assistance from other team members.	☐	☐	☐	☐	☐
b. Team members depended on me for information/assistance to perform the task.	☐	☐	☐	☐	☐
c. Jobs performed by the team members are related to one another.	☐	☐	☐	☐	☐

20) Please indicate how much you agree with the followings statements.
(1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree)

	1	2	3	4	5
a. I enjoyed performing this telephone kit assembly task.	☐	☐	☐	☐	☐
b. Assembling the telephone kit was a complex task.	☐	☐	☐	☐	☐
c. Assembling the telephone kit was a difficult task.	☐	☐	☐	☐	☐

21) To what extent do you agree with the following statements? When the questions refers to 'my team members', it refers to the members of the team that you belong to NOW.
(1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree)

	1	2	3	4	5
a. My team members and I worked together as a cohesive team.	☐	☐	☐	☐	☐
b. I understood what my team members were doing and why.	☐	☐	☐	☐	☐
c. My team members and I communicated well.	☐	☐	☐	☐	☐
d. I trusted my team members' skills.	☐	☐	☐	☐	☐
e. My team members and I shared our ideas and concerns.	☐	☐	☐	☐	☐
f. My team members and I were familiar with each other's knowledge and skills.	☐	☐	☐	☐	☐

Appendix 10: How to Measure Transactive Memory Consensus and Accuracy

(Austin, 2003, pp. 876-877)

3. Transactive Memory Consensus

Transactive Memory Survey Question:
For each skill or area of knowledge listed below, write the name of the team member(s) that you believe is most knowledgeable in that particular skill or area.

Table A3a
Identified Experts

	Skill			
	1	2	3	4
Person A	Person B	Person C	Person A	Person A
Person B	Person B	Person A	Person A	Person C
Person C	Person B	Person A	Person A	Person B

Step 1: For each skill, responses are recorded by assigning a number for each unique identified expert (Table 3b). The most frequently identified expert for that skill is coded as 1, the next most frequently identified expert is coded as 2, and so forth. Note that this coding strategy transforms the categorical variable into an ordinal variable.

Step 2: A standard deviation score is calculated for each skill, indicating group consensus on identification of group experts for that skill.

Step 3: Skill consensus scores (standard deviation measures) are averaged to create a single group consensus score.

Step 4: The group consensus score is transformed using a $1 - x$ transformation; thus, a higher score indicates greater group consensus.

Table A3b
Skill Expertise Ranking Scores

	Skill			
	1	2	3	4
Person A	1	2	1	1
Person B	1	1	1	2
Person C	1	1	1	3
SD	0.00	.58	0.00	1.00

Group consensus score = (0 + .58 + 0 + 1)/4 = .395.

Transactive memory consensus = 1 − .395 = .605.

5. Transactive Memory Accuracy (Self-Report)

Step 1: Self-report expertise scores (Table 1) are linked with identified expert scores (Table 3a) to create accuracy of identified experts scores for each individual and skill. See Table 5 and explanation below.

Step 2: For each individual, skill accuracy scores (Table 5) are averaged to create a single individual expertise accuracy score.

Step 3: The individual expertise accuracy scores are averaged to create a group transactive memory accuracy score.

Table A5
Accuracy of Identified Experts

	Skill				
	1	2	3	4	*M*
Person A	5	3	5	3	4.00
Person B	5	5	5	3	4.50
Person C	5	5	5	4	4.75

Person A identified Person B as expert at Skill 1 (Table 3a). Person B rated his own expertise at Skill 1 as a 5 (Table 1). Person A's accuracy score for Skill 1 is 5 (Person B's self-rated expertise for Skill 1; Table 5).

Transactive memory accuracy = (4.00 + 4.50 + 4.75)/3 = 4.42.

1. Group Task Knowledge Stock (Self-Report)

Self-report survey question:

For each skill/area of knowledge, please record the number tl corresponds with your evaluation of your ability in that skill/area knowledge.

1	2	3	4	5
Very Low	Low	Average	High	Very Hi

Step 1: Skill self-report scores are averaged to create a sin individual skill score.

Step 2: Individual skill scores are aggregated to create a group ta knowledge stock score.

Table A1

Skill Self-Report Scores

	Skill				
	1	2	3	4	I
Person A	4	5	5	3	4.
Person B	5	2	4	4	3.
Person C	3	3	2	3	2.

Group task knowledge stock = 4.25 + 3.75 + 2.75 = 10.75.

Appendix 11: Results Test of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Familiarity Task	.15	26	.13	.96	26	.48
Familiarity Working together	.17	26	.05	.93	26	.06
Team Members Seem Familiar	.11	26	.20*	.96	26	.32
Stress	.13	26	.20*	.95	26	.21
Interdependence	.07	26	.20*	.97	26	.60
Enjoy	.18	26	.03	.93	26	.09
Complex	.14	26	.17	.96	26	.40
Difficult	.11	26	.20*	.96	26	.39
Cohesiveness & Cooperation	.15	26	.14	.96	26	.32
Time taken till 'completion'	.45	26	.00	.42	26	.00
No. of missing parts	.12	26	.20*	.94	26	.11
No. of mistakes made	.12	26	.20*	.97	26	.73
TMS sharedness after practice	.12	26	.20*	.98	26	.86
TMS accuracy after practice	.11	26	.20*	.98	26	.80
TMS sharedness after performance	.19	26	.01	.95	26	.20
TMS accuracy after performance	.10	26	.20*	.90	26	.62
Collective Recall	.12	26	.20*	.97	26	.72

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Appendix 12: Results Test of Normality within Groups

Tests of Normality[b]

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Treatment	Statistic	df	Sig.	Statistic	df	Sig.
Familiarity Task	Control	0.30	4	.	0.79	4	0.09
	Early	0.22	12	0.10	0.92	12	0.32
	Late	0.22	10	0.19	0.90	10	0.19
Experience Working Together	Control	0.25	4	.	0.92	4	0.51
	Early	0.18	12	0.20*	0.90	12	0.16
	Late	0.25	10	0.08	0.90	10	0.22
Team Members Seem Familiar	Control	0.16	4	.	0.99	4	0.97
	Early	0.23	12	0.08	0.93	12	0.34
	Late	0.17	10	0.20*	0.87	10	0.10
Stress	Control	0.26	4	.	0.83	4	0.16
	Early	0.16	12	0.20*	0.94	12	0.56
	Late	0.25	10	0.09	0.83	10	0.03
Interdependence	Control	0.21	4	.	0.93	4	0.61
	Early	0.15	12	0.20*	0.93	12	0.35
	Late	0.18	10	0.20*	0.91	10	0.27
Enjoyment	Control	0.21	4	.	0.95	4	0.71
	Early	0.31	12	0.00	0.68	12	0.00
	Late	0.16	10	0.20*	0.93	10	0.50
Complexity	Control	0.15	4	.	0.99	4	0.97
	Early	0.30	12	0.00	0.78	12	0.01
	Late	0.14	10	0.20*	0.98	10	0.93
Difficulty	Control	0.36	4	.	0.84	4	0.19
	Early	0.11	12	0.20*	0.98	12	0.98
	Late	0.21	10	0.20*	0.87	10	0.11
Cohesiveness & Cooperation	Control	0.27	4	.	0.94	4	0.67
	Early	0.14	12	0.20*	0.97	12	0.91
	Late	0.17	10	0.20*	0.91	10	0.31
Time taken till 'completion'	Control	0.30	4	.	0.82	4	0.13
	Late	0.43	10	0.00	0.64	10	0.00
No. of missing parts	Control	0.26	4	.	0.90	4	0.41
	Early	0.13	12	0.20*	0.92	12	0.33
	Late	0.20	10	0.20*	0.90	10	0.20
No. of mistakes made	Control	0.35	4	.	0.87	4	0.28
	Early	0.16	12	0.20*	0.96	12	0.75
	Late	0.18	10	0.20*	0.91	10	0.30
TMS sharedness after practice	Control	0.27	4	.	0.85	4	0.24
	Early	0.19	12	0.20*	0.97	12	0.86
	Late	0.17	10	0.20*	0.93	10	0.48
TMS accuracy after practice	Control	0.24	4	.	0.96	4	0.79
	Early	0.17	12	0.20*	0.96	12	0.81
	Late	0.13	10	0.20*	0.96	10	0.76
TMS sharedness after performance	Control	0.27	4	.	0.95	4	0.71
	Early	0.28	12	0.01	0.88	12	0.08
	Late	0.19	10	0.20*	0.94	10	0.53
TMS accuracy after performance	Control	0.28	4	.	0.94	4	0.68
	Early	0.16	12	0.20*	0.93	12	0.43
	Late	0.23	10	0.16	0.86	10	0.07
Collective Recall	Control	0.29	4	.	0.87	4	0.29
	Early	0.18	12	0.20*	0.93	12	0.39
	Late	0.17	10	0.20*	0.93	10	0.45

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

b. Time taken till 'completion' is constant when Treatment = Early. It has been omitted.

Appendix 13: Output Levene's Test

Test of Homogeneity of Variance[a]

	Levene Statistic	df1	df2	Sig.
Familiarity Task	0.85	2	23	.44
Experience Working Together	0.28	2	23	.76
Team Members Seem Familiar	0.72	2	23	.50
Stress	0.81	2	23	.46
Interdependence	1.19	2	23	.32
Enjoy	0.64	2	23	.54
Complex	0.69	2	23	.52
Difficult	0.45	2	23	.64
Cohesiveness & Cooperation	1.09	2	23	.35
Time taken till 'completion'	138.19	1	12	.00
No. of missing parts	2.09	2	23	.15
No. of mistakes made	0.28	2	23	.76
TMS sharedness after practice	0.52	2	23	.60
TMS accuracy after practice	0.26	2	23	.77
TMS sharedness after performance	0.72	2	23	.50
TMS accuracy after performance	0.90	2	23	.42
Collective recall	1.84	2	23	.18

a. Time taken till 'completion' is constant when Treatment = Early. It has been omitted.

Appendix 14: Results of One-way ANOVA

ANOVA

				Sum of Squares	df	Mean Square	F	Sig.
Time taken till 'completion'	Between Groups		(Combined)	12,69	2	6,34	8,06	0,00
		Linear Term	Unweighted	9,10	1	9,10	11,56	0,00
			Weighted	5,25	1	5,25	6,66	0,02
			Deviation	7,44	1	7,44	9,45	0,01
		Quadratic Term	Unweighted	7,44	1	7,44	9,45	0,01
			Weighted	7,44	1	7,44	9,45	0,01
	Within Groups			18,11	23	0,79		
	Total			30,80	25			
No. of missing parts	Between Groups		(Combined)	3,33	2	1,66	0,19	0,83
		Linear Term	Unweighted	3,15	1	3,15	0,36	0,56
			Weighted	2,43	1	2,43	0,28	0,60
			Deviation	0,90	1	0,90	0,10	0,75
		Quadratic Term	Unweighted	0,90	1	0,90	0,10	0,75
			Weighted	0,90	1	0,90	0,10	0,75
	Within Groups			203,02	23	8,83		
	Total			206,35	25			
No. of mistakes made	Between Groups		(Combined)	33,30	2	16,65	2,43	0,11
		Linear Term	Unweighted	24,86	1	24,86	3,63	0,07
			Weighted	14,86	1	14,86	2,17	0,15
			Deviation	18,44	1	18,44	2,70	0,11
		Quadratic Term	Unweighted	18,44	1	18,44	2,70	0,11
			Weighted	18,44	1	18,44	2,70	0,11
	Within Groups			157,35	23	6,84		
	Total			190,65	25			
TMS sharedness after performance	Between Groups		(Combined)	0,04	2	0,02	1,16	0,33
		Linear Term	Unweighted	0,02	1	0,02	1,41	0,25
			Weighted	0,03	1	0,03	2,03	0,17
			Deviation	0	1	0,00	0,30	0,59
		Quadratic Term	Unweighted	0	1	0,00	0,30	0,59
			Weighted	0	1	0,00	0,30	0,59
	Within Groups			0,38	23	0,02		
	Total			0,42	25			
TMS accuracy after performance	Between Groups		(Combined)	0,08	2	0,04	0,50	0,61
		Linear Term	Unweighted	0,03	1	0,03	0,41	0,53
			Weighted	0,01	1	0,01	0,14	0,71
			Deviation	0,07	1	0,07	0,86	0,36
		Quadratic Term	Unweighted	0,07	1	0,07	0,86	0,36
			Weighted	0,07	1	0,07	0,86	0,36
	Within Groups			1,79	23	0,08		
	Total			1,86	25			