Role of Enriched Representations in Collaborative Planning Processes

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ROLE OF ENRICHED REPRESENTATIONS IN
COLLABORATIVE PLANNING PROCESSES

A dissertation submitted in partial fulfillment of the
requirements for the degree of

Doctor of Philosophy

By

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ABSTRACT

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Role of Enriched Representations in Collaborative Planning Processes.

The current study addressed the function of representing constraints in a display that is used for the process of planning on a team level. The experimental task was a modification of a game entitled *10 Days in Africa* in which the players must complete a journey through the continent of Africa. Dyads participated in the game by constructing their own planning representations, as well as collaborating with the other player. We augmented the standard Gantt chart representation of timeline events with representations for the constraints holding between adjacent events. To examine the function of constraint representation in planning, we examined the effect of two different types of representations, Color and Text. Both representations should suffice if the function is simply to bring the constraint closer to the elements it constrains (Zhang & Norman, 1994). On the other hand, Color functions as a perceptual feature that is effective without attentional resources, and could serve to organize the planning process automatically, whereas Text requires attentional resources to influence the planning process. The role of Text should therefore depend on planning strategy. Manipulation of low level cognitive properties of representing constraints (Color and Text) occurred within the planning representation itself or in a supplementary map. We found that representing constraints in general affected both performance as well as planning strategies. Color resulted in generally improved performance. Color functions as a feature that facilitates performance by allowing for emergent properties and chunking. However, when constraints were represented via Text, Males and Females employed different strategies, with Females
demonstrating an increased tendency to be opportunistic. These results show that the type of representation is relevant to the effect of proximity in the representation of constraints for planning.
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I. INTRODUCTION

The present research examines the effect of representing constraints on individual and collaborative planning activities. A standard representation for plans in many real world settings is Gantt charts. For example, NASA mission control utilizes Gantt charts to represent the schedule of activities on the international space station (Figure 1). These ubiquitous representations consist of a type of bar graph that illustrates summary elements of a project schedule. These charts apparently communicate and identify sequences of activities effectively. However, we lack a body of literature to account for how they influence the processes underlying planning. In addition, traditional planning and scheduling charts for human work represent schedules for individuals, i.e. an individual is the primary resource. Thus, they leave implicit the constraints for intended activities in terms of other individuals and resources involved.

Relative to Gantt charts, novel project management representations take into account the constraints on activities, particularly concerning collaborative requirements. Burkhard, Meier, Rodgers, Smis and Stott (2007) explored visual metaphors in designing representations for planning. Specifically, the authors applied a Tube Map technique to represent a project schedule (See Figure 1 as an example of a Tube Map representation of NASA activities highlighted in red in Figure 1). In its more standard application, a Tube Map represents the topological layout of the London Underground stations and the various opportunities for changing rail lines, originally represented in this manner by the electrical engineer Harry Beck in 1931. Virtually every major urban rail system uses a version of Beck’s concept, which sacrifices a veridical distance representation to highlight opportunities to transfer between lines. However, Burkhard, et al. (2007) used
Figure 1. Gantt chart used by NASA mission control to represent activities on the international space station (reproduced from JSC, 1996).

Figure 2. Example of a Tube Map representation of activities on the international space station that were highlighted in red in Figure 1.
the Tube Map metaphor to represent the exchange of information within a project. Specifically, the tube lines were meant to represent project groups; and tube stations represented project tasks and points of collaboration. Although, this type of representation still omits important context information it has several advantages over the traditional representation. Specifically, the Tube Map representation communicates points of collaboration between individuals involved in a project. It allows for establishment of a mutual story between the individuals involved, complete with time markers for significant events. Project managers, students, and employees from large organizations participated in a usability-evaluation of this application. These participants recalled the details of the tube map better than details of a Gantt chart several weeks later. This informal evaluation suggests the potential benefits of incorporating the constraints between planned activities (e.g. collaboration or co-location) into the representation.

The present study concerns the properties of representations suitable for team planning tasks. We are specifically concerned with constructing a sufficient representation of a plan that incorporates the necessary aspects of the constraints and rationale behind the intended activities.

This introduction first reviews the literature in the area of planning. As the processes of planning depend upon the planning representations, the introduction then addresses the cognitive and perceptual issues underlying reasoning about graphical and textual representations in the areas of situated action, human factors (HF), and cognitive psychology. The introduction concludes by addressing the need to incorporate collaboration and resource sharing into representations for planning.
Planning

Planning is the process of designing a sequence of activities that are required to achieve a desired future state (Clancey, 1986, Genesereth & Nilsson, 1987; Sacerdoti, 1975). Scheduling involves an additional component of a time scale. Planning and scheduling tasks appear in many real-world domains, such as transportation, manufacturing and military operations. Planning and scheduling generally rely heavily upon the usage, creation, and modification of external representations such as schedules, documents, or diagrams. Cognitive demands arise from the distributed nature of representations as well as from the processes involved in planning and scheduling. From a computational perspective, Polyak and Tate (1998) defined planning as a type of problem solving in which specific goals are identified. The authors suggested that plans are susceptible to the means-ends analysis that Newell and Simon (1963) discussed. More specifically, the evaluation of a plan hinges on the number of elements of the plan that contribute to goal achievement. Tate (1975) (as cited in Currie & Tate, 1991) developed an approach to plan evaluation in which each element of a plan is a node that is weighted according to its contribution to goal achievement. As the complexity of planning is a factorial of the number of plan elements, hierarchical planning effectively consolidates the number of elements considered during the planning process, by chunking them. This approach incorporates more detail at lower levels of the plan structure and less detail at the higher levels (Sacerdoti, 1975; Tate, 1975). Sacerdoti’s (1975) computer program formulates plans as problems in terms of higher level goals, which are expanded into sub-goals and so on. Like Tate (1975) the complete plan ultimately consists of a series of
simple actions, but unlike Tate, the planning process does not consider each action separately at the outset.

*Human Planning*

The limited research on human (as opposed to computer) planning and scheduling addresses some real world applications. Specifically, planning and plan adjustment are activities that are highly situated within their environment and are influenced by cognitive factors such as experience and opportunities (driven by memory and organization of knowledge). A line of research on opportunistic planning has examined how individuals plan in context of their environment.

*The role of experience.* Prior experience plays a critical role in formulating and modifying plans. Schank and Abelson (1988) argued that knowledge consists of scripts of stereotypical situations with routine activities. These scripts arise though experiences either directly or vicariously. Hammond (1990) examined case-based planning, which focuses on the use of previously successful specific plans rather than the generation of plans from general principles. These authors suggest that rather than re-planning, people should adapt and reuse plans that have successfully worked in the past. Thus, previous experience applies to future planning and plan modification. Similarly, we utilize scripts and schemas acquired via experience for related situations (Lichtenstein & Brewer, 1980; Shank & Abelson, 1988). Although this is an effective way of understanding planning for familiar situations, exceptional discrepancies require extensive modifications to the existing knowledge.

*Opportunistic planning.* Another line of research emphasizes the role of the situation in the process of formulating plans. Hayes-Roth and Hayes-Roth (1979) had
subjects verbally formulate plans for a day of errands around town using a map of the
town. Specifically, subjects received a scenario complete with time constraints and a set
of errands to complete in a single day. Using a map of the town, subjects verbalized the
sequence of errands that they planned to complete. The sequencing of tasks was
determined based on the errand’s location on the map, timing, and the priority of the task.
Planning hinged upon the layout of the town and the constraints and opportunities
associated with the layout. For example, the subject might plan to go to the health club
and then to the nearby veterinarian. Thus, opportunities became grouped or organized
together based on geographical proximity. The authors concluded that everyday planning
is largely opportunistic and adaptive in that subjects take opportunities that arise from the
environment as the task progresses (Hammond, 1990; Hayes-Roth and Hayes-Roth,
1979). A special property of such a plan is that each step is completely dependent on
preceding and subsequent steps. In other words, each step occurs in the context of the
progress of the entire plan. In opportunistic planning, the pending goals are postponed if
they do not fit into the current, on-going activity and are only completed when
opportunities arise. Thus, planning and plan modification are situated activities that are
dependent upon the constraints of the environment in which it is occurring.

Models of opportunism focus on encoding of pending goals in memory. The
environment provides cues for retrieval of a pending goal, for example the availability of
objects in the environment that may serve as resources. Siefert and Patalano (2001)
provided subjects with novel objects to determine whether subjects perceive those as
providing an opportunity for goal achievement. For instance, would the presence of
Vaseline cue subjects to remove a stuck ring (Seifert & Patalano, 2001; Seifert, 2001)?
The authors concluded that novel or ambiguous objects (like Vaseline) in fact are seen as opportunities for goal achievement. This is consistent with Barsalou’s (2003) ideas about the action-environment interaction in the achievement of goals. Barsalou argued that human knowledge organization supports retrieval of information based on opportunities (driven by memory of pending goals). Thus, we are able to cross functional category boundaries in the resources that we might use to achieve goals. The introduction of novel objects in the environment creates possibilities for goal achievement by providing cues to prime the activation of appropriate features of the objects (Barsalou, 1983).

Situated action. Suchman (1987) argued that the specific physical and social circumstances of the environment shape such activities at least as much as activities (or plans) shape the situation. To support her claims, she examined dynamic environments requiring collaboration between people and interaction with technology. She observed that the situation in which activity takes places is ever-changing and thus, people need to adjust their behavior constantly. Suchman argued against the role of plans in advance of action, as plans will necessarily undergo continuous adjustment and modification according to the situation. However, Suchman studied behavior in relatively benign environments; in complex and technologically-rich environments involving multiple people, planning must occur a priori in order to manage scarce resources and avoid the adverse consequences of conflicting sequences of actions.

In summary, Suchman outlined how individual activity is situated within the environment of situational constraints, people, and tools based on observations of people doing real-world activities. The process of planning and scheduling is complex because it is concerned with organizing activities that take place within a dynamic environment that
is made up of (and requires the use of) other individuals and resources. Thus, a reasonable conclusion is that representations for planning and scheduling should accommodate these critical aspects of the environment in some manner. Research on human planning should enable a better representation of actual activities in a priori plans by incorporating the situation, particularly resources, into account.

Planning Representations. Few laboratory studies have examined types of planning representations. Day (1988) examined four displays of bus schedules varying in semantic grouping of information. Subjects had to memorize the symbols and either recall or do a matching task of their meaning. Semantic grouping (e.g., holidays) facilitated performance by supporting chunking, suggesting that organized and meaningful lists are easier to remember. Day found that memory for bus schedules varied across alternative representations. Semantic grouping of information implemented in Day’s representations is consistent with processes underlying reasoning about representations.

Representations

Two lines of research inform the representation of information. The applied discipline of human factors focuses on the design of external representations for the task domain to support task performance, typically real time control. Complementary research in cognitive psychology specifically addresses the processes underlying reasoning about different types of representations. The following section will outline the current state of research in the area of representations drawing on both the human factors and cognitive psychology literatures. Both literatures have considered the advantage of graphical over
text representations, considering emergent features, attentional demands, external memory, and place-keeping.

**Graphical versus textual representations**

Studies of representations reveal better performance for graphical rather than textual formats (Bauer & Johnson-Laird, 1997; Larkin & Simon, 1987). Later sections in this review indicate the specific advantages of graphical representations, but most generally, the contrast is simply a striking illustration of the impact of representation on problem solving. Zhang and Norman (1994) argued that reasoning is distributed across internal and external representations. The type of physical representation determines the information that is depicted externally by that representation as well as the information that needs to be kept and processed internally (i.e., in memory, etc.). The interaction between the internally versus externally distributed information drives the perceptual and cognitive processes involved in reasoning about the representation, thus, determining the level of difficulty of reasoning about the external representation. Consistent with the previous discussion, graphical representations result in better performance because the relationships between elements in a graphical representation are more evident and emergent. The same relationships in textual representation impose a greater cognitive demand due to the need for more internal processing, resulting in decreased performance (Zhang & Norman, 1994).

In general, the properties of a representation can influence an individual’s conception of a problem and thus, the ease of finding a solution (Gick & Holyoak, 1980; 1983). General support for the claim that representation influences problem solving also arises from the work on problem isomorphs. Those problems have identical underlying
structure (as revealed by a state-space analysis) are called isomorphs. Simon and Hayes (1976) and Kotovsky, Hayes, and Simon (1985) examined a series of Tower of Hanoi problem isomorphs (The Monster Problem, etc.). These authors found that despite isomorphic problem spaces, some problems are harder to solve than others. The authors also documented the absence of transfer between apparently isomorphic problems. This establishes the influence of superficial features on the way people develop and remember solutions.

The human factors construct of informational equivalence converges with the cognitive science construct of problem isomorphs. Some HF research has argued that identical information is being presented across graphical and textual representations. Yet, the HF line of research consistently reveals that performance on various tasks varies across the representations, undermining the claimed equivalence (Bauer & Johnson-Laird, 1997; Larkin & Simon, 1987). Perhaps the same information is available across the representations, but it may be more or less explicit, requiring different processes and varying amounts of cognitive effort to retrieve.

In the cases of both isomorphic problems and informationally equivalent representations, the way that a problem is represented (despite isomorphic structures) plays a role in how people reason about it. This structure determines which information is salient and emergent, versus cognitively demanding. In other words, problem representation will determine how much information is more or less apparent (external) versus how much information needs to be extracted in the head (internal). This general claim is explored further below specifically for graphical versus textual representations.
Larkin and Simon (1987) examined individual problem solving in geometry and physics as a function of either diagrammatic or text representations. They concluded that a diagrammatic format supported more efficient search and more effective recognition, due to the topological mapping of the objects that is lacking in the text condition. A study by Bauer and Johnson-Laird (1997) also examined a diagrammatic versus text format for representing problems. Their schematic diagrams involved electrical circuits and a jigsaw puzzle. Subjects reasoned about the problem by mentally transforming parts of the diagram. Indeed, the diagrammatic format also resulted in better and faster performance. The authors attributed this result to a more explicit representation of problem states and solutions in a diagram.

Emergent features. Larkin and Simon (1987) were not only interested in the difference in performance resulting from the two types of representations, but also what accounts for that performance. Thus, they believed that the answer lay with the relationships between the features of the graphical representation such as the components of the physics problem. They argued that the diagram allows for more inferences to pop out or emerge than the sentential representation (Hutchins, 1990; Larkin & Simon, 1987; Zacks & Tversky, 1999). Human factors labeled this idea, emergent features (Pomerantz & Pristach, 1989; Sanderson, et al., 1989). Emergent features become evident in representations that have been configured in such a way that a combination of values or elements produces an additional piece of information.

Human factors has long focused on achieving display design principles that produce emergent features, e.g., the proximity-compatibility principle (Wickens & Carswell, 1995). The principle operates by postulating an attentional glue that fuses
together the to-be-integrated elements into a chunk to produce emergent features. Wickens and Carswell argued that this principle of integration is better served by more object-like or graphical representations. Bennett and Flach (1992) examined processing capabilities for various types of visual features in graphical representations. They concluded that the effectiveness of graphical decision support depends upon the presence of highly salient emergent features in graphical displays, such as color. Numerous other studies have found support for this idea by concluding that bar graphs support emergent features (Carswell & Wickens, 1990; Zacks & Tversky, 1999).

Often successful tools and artifacts in the real world support the occurrence of emergent features, with no intent from the designer. For example, in his examination of Micronesian navigation, Hutchins (1995) analyzed various tools including the navigational chart. Hutchins claimed that a chart is more than just a compilation of observations. A chart has more information than was put there by the designer in the emergence of numerous distance relationships between locations, some of which have never been measured before. As a result, what appears in the chart is more than what the chart designer observed. Other representations that Hutchins discussed support the idea of emergent relationships that were not put there intentionally, such in an astrolabe.

The above-mentioned research concludes that graphical representations result in better performance due to their support of emergent features as guided by the proximity-compatibility principle. The human factors literature also suggests other design principles concerning the effective use of color, font size, groupings, length, angle, area, volume (Cleveland & McGill, 1986; Tufte, 1990; Smith & Mosier, 1986) and number (Yntema & Muesler, 1966) in the design of representations to facilitate performance.
Attentional demands. External representations require visual search. Depending on the elements of the representation, visual search may occur more or less efficiently. Treisman and Gelade’s (1980) Feature Integration Theory (FIT) used a response time paradigm to argue that we readily process basic characteristics like color, shape, and orientation in parallel. Parallel processing implies that little attention is needed to locate these characteristics in a visual search task. In other words, those characteristics that pop-out are similar to emergent features discussed earlier. Thus, the authors dubbed these characteristics *features* (as not requiring attentional resources). Treisman and Gelade (1980) initially argued that if object identification requires a conjunction of features, attentional resources must play a role (also Treisman, 1986). However, Treisman’s later research (1998) as well as Wolfe (1994) argued that the binding of these features into objects requires little attention and results in efficient search, as measured in milliseconds of response time. Wolfe also expanded Treisman and Gelade’s original Text of features to include more complex characteristics. In a revised FIT Treisman (1998) supported Wolfe’s idea and focused on the perception of objects and discussed the role emergent properties in visual search.

Zhang and Norman (1994) incorporated color as a feature of their external representations of Tower of Hanoi. The presence of color facilitated performance by reducing attentional demand. Similarly, even a combination of color with other features should not result in a competition of attentional resources.

External memory and memory aids. Larkin and Simon (1987) concluded that the reason a diagram yields better performance than a sentential representation is that it serves as a type of external memory. Zhang and Norman (1994) also argued that external
representations serve as memory aids. Specifically, information via diagrams or physical objects is permanently available for reference. The processing of internal information, on the other hand, would result in interference of other processes as they would be in competition for working memory resources (Zhang & Norman, 1994).

Zhang and Norman argued that external representations structure cognitive behavior in promoting and prohibiting certain actions, thereby changing the nature of the task. Specifically, they discussed problem solving rules as internal and external representations. Internal rules require memorization. In contrast, external rules are implicit in the physical configuration of the representations and are therefore, emergent. Whether the rules are internal or external dictates the distribution of the problem space. A series of experiments on the Tower of Hanoi problem conducted by Zhang and Norman demonstrated better performance for more externalized rules. The authors attributed this result to the fact that external rules are more available perceptually or physically determined. Thus, external representation of information seems to be less cognitively demanding than internal representation.

Place-keeping. The organization of elements in an external representation can also facilitate other cognitive processes. For example, if elements in a representation are moveable, counting of those elements becomes more efficient. Smith, Greeno, and Vitolo (1989) examined children’s competence for “counting” objects arranged in a straight line. Their findings showed that performance was improved for moveable rather than stationary objects. Movable objects enable grouping in the physical representation to distinguish between counted and uncounted objects. If objects are immovable, they must be tagged or marked mentally. Thus, external representations that allow for the
movability of graphical objects may result in superior counting performance. The physical persistence of elements that have been acted upon in a representation may support reasoning about those elements. This can be likened to a game of Solitaire, where cards are moved around and will continue to persist with varying degrees of availability for subsequent steps.

In summary, the way in which information is represented determines how much perceptual and cognitive processes underlie reasoning about the representation. Elements that support efficient visual search (such as color) reduce the demand on perceptual resources. Likewise, information that is represented externally reduces the demand on cognitive resources. Representations that take into account these issues may facilitate reasoning. By nature of its structure, graphical rather than textual versions of external representations, support perceptual and cognitive processes more effectively and efficiently.

Limitations of Research on Representations

Research on representations provides guidelines on how to design representations to ensure effectiveness and efficiency, as well as what attentional and cognitive functions play a role in reasoning about them. However, it does not address multi-user collaboration.

Single- versus Multi-User Representations

One unique demand for multiple problem solvers is the need to collaborate. In the real world environment such as JPL at NASA or the military, people must work collaboratively, in groups or teams on various types of activities. In this research we are specifically concerned with the representation of constraints and the processes underlying
the usage of these representations. A few studies address team performance in highly abstract, conceptual military tasks (Cooke, et al., 2007). However, much literature on representations addresses performance on the level of a single individual. Many studies assume that one can generalize individual performance, and the variables that influence it, to group performance. However, we have limited empirical evidence to support this claim. Also, collaboration itself draws upon additional cognitive resources, which may result in performance decrement, or overwhelm low level manipulations. Thus, one of the questions to address is whether the representational principles that improve individual performance result in the improved performance of multiple individuals collaborating.

Communication. Anthropologists have examined collaborative activity in the context of communities of practice (informal information sharing) that emerge within organizations. Lave and Wenger (1991) argued that knowledge sharing is a highly collaborative activity that relies on effective communication. In order for effective communication to take place, certain information must be shared among the participants. Clark and Brennan (1991) refer to this foundation as common ground, which encompasses “mutual knowledge, mutual beliefs, and mutual assumptions.” Common ground is the backbone of any coordinated activity and informal knowledge sharing within a community of practice. The research on communication gives us some insight into the processes of collaboration.

The anthropologist Star (1989) introduced the idea of boundary objects used across different individuals and communities, and thus, for different purposes. The purpose and meaning of the boundary objects changes depending on who is using it and why (Nitzgen, 2004; Star, 1989; Star & Bowker, 2000; Star & Griesmer, 1989).
Boundary objects are critical in distributed and collaborative work. For example, a set of blueprints of a house may be scrutinized by different individuals at different levels of abstraction depending on their goals (e.g., plumbing versus home décor). This research has highlighted the importance of designing representations to allow for such a varied usage.

Boundary objects also provide for common reference based on shared visual access. Horton and Keysar (1996) examined the role of shared visual access in the planning of utterances. The authors looked at the speakers’ referential descriptions, as a function of shared versus privileged visual context that was available to the speaker and the listener. Spatial references are parts of speech, which may be used to a greater or lesser degree depending on whether speakers have shared visual access. In other words, information shared between the subjects may be impacted by the information that is made explicit in the representation (Horton & Gerrig, 2005). For example, *a* and *the* are articles, which are combined with nouns to indicate the type of reference being made to the noun. The article, *a*, is an indefinite article that refers to any noun, often one that the speaker believes is not the listener’s focus of attention. On the other hand, the article, *the*, is a definite article and refers to a particular noun that both the speaker and listener recognize. Also, *this* and *that* are demonstratives. Demonstratives are parts of speech that indicate unnamed, but understood entities. Finally, *here* and *there* in pronoun form are also spatial referents that conversational partners understand when they share a context. With shared visual access, language may demonstrate such references to specific elements, without need for elaboration.
The research of Suchman and Star, described above is observational and anthropological in nature. Thus, it lacks the methods and rigor of laboratory research to standardize the reasoning setting, control independent variables, and quantitatively examine a common measure of performance. Also, the research examined limited task domains. In addition, Suchman (1987) argued that situations are too dynamic and planning is not possible, whereas Star (1989) focused more on representations rather than the lower-level planning process using them. This study is concerned with the planning processes underlying complex activities.

Resource Sharing and Collaboration

As mentioned at the outset, traditional plans and schedules do not represent the resources that they use. Work activities often require the usage of a common pool of resources and the management of resources among the involved individuals (Hutchins, 1995). Resources are frequently of a limited quantity and thus must be shared across individuals at different points in time. They are objects used by a community of collaborating individuals in order to achieve a goal. Shared resources are a source of supply that can be drawn upon in time of need. As these issues of collaboration and resource sharing in work activities are so critical, might planning performance be facilitated by representing these elements in scheduling representations? Thus, we would like to enrich the traditional tool of planning/scheduling with additional features that may facilitate performance by reducing cognitive load.

Distributed Representations with Resources and Collaboration

Although time is the basis for the organization of traditional planning representations, few studies have examined collaboration and resource sharing. Gallimore
(2005) conducted a series of studies using additional, adjacent decision support tools that allowed subjects to examine the identity and current status of resources needed for their activities. The present experiment will integrate the representation of resources and the constraints of their usage, within the plan itself.
II. METHOD

Experimental Task

The present experimental task was a modification of a game entitled *10 Days in Africa: The Unpredictable Game of Making Connections* (Moon & Weissblum, 2004). In the original game, the players must complete a ten day journey through the continent of Africa. Specifically, each player must compile a set of ten cards (or tiles) that represent countries and the vehicle of transportation between these countries (each country counts as a single day and each vehicle counts as a single day). To complete this task, players use a map of Africa with color-coded countries. A mode of transportation is required to travel between the countries as determined by the color coding scheme and the countries’ geographical location on the map. The three modes of transportation used in the original game are traveling by foot (does not require a tile), traveling by automobile, and traveling by airplane. The constraints in regards to these tools are the following:

1. Foot – adjacent countries, regardless of color, can be crossed by foot
2. Car – an automobile can be used to drive from one country to another, by driving through a country that borders them both (i.e. adjacency once removed)
3. Airplane – an airplane can be used to fly from one country to another of the same color

The pieces of the original game include 45 country tiles, 15 transportation tiles (ten airplane tiles: two per each of five colors, and five automobile tiles), card holders, map of Africa, and a set of rules. Each player begins by filling their card holders by drawing cards and placing them in the holder. The remaining tiles are placed face down to form an Unknown pile. The three top tiles are placed face up to form three Known
piles. The game is played by players taking turns drawing a tile from either the Unknown pile or any of the three Known piles. The player has the option of either discarding the drawn tile or replacing any of their tiles with the drawn tile. If a tile is replaced, then it should be discarded face up into any of the discard piles.

**Modified Game Properties**

The game was modified in a number of ways for use as the experimental task. First, for all experimental conditions, it was implemented electronically, to facilitate data recording. We also increased the need to work collaboratively. As in the original game, subjects drew from a shared pool of resources (Planes or Cars) that were required as part of the plan. Participants were instructed to agree on a three tile rendezvous in each plan, on the same set of days. Specifically, two country tiles and one transportation tile defined a rendezvous, while the other four country and four transportation tiles were not constrained. In order to increase the chances of subjects being able to obtain identical tiles for the meetings, the number of tiles used in the game was increased; resulting in three tiles per country, six tiles for each color of plane, and a total of six car tiles. The game allowed for 280 possible plane trips and 173 possible car trips. Third, the task did not include transportation based on the constraint of adjacency once-removed. As a result, the task incorporated only two modes of transportation (Plane and Car) depending on color and adjacency respectively. Fourth, the plan needed to begin and end with a country tile and a valid transportation tile needed to separate all other country tiles. Thus, the completed plan consisted of eleven tiles, resulting in six country tiles and five transportation tiles. Finally, a color-coded map of Africa was available in physical form
in all conditions, just as in the original game. The electronic record of moves as well as
the participants’ verbalizations served as dependent measures.

*Physical persistence of tiles.* Physical persistence of the country and resource tiles
was also ever-present, rather than manipulated in the task. This idea was motivated by
Smith et al.’s (1989) results that subgoaling moveable objects is easier than stationary
objects. Specifically, as the nascent plan was modified, the country and resource tiles
were moved in and out of it and they continued to persist to varying degrees. Thus, the
persistence of the tiles was another way of providing information of whether resources
were available, in use, or hidden. The degree of the availability of the tiles determined
how helpful this information was. We investigated this type of information by examining
the number of tiles drawn from Known versus Unknown piles.

*Resource sharing and collaboration.* Collaboration was a pervasive property in all
task conditions. More specifically, each of the two individuals independently worked on
their own eleven-day trip plan. As a team, the players were required to arrange a set of
meeting places of a sequence of three cards (country-vehicle-country); to be implemented
on identical set of days for both players. The cards and days were determined and
negotiated by the subjects as a team. The subjects shared visual access of both planning
representations, thus they maintained knowledge of each other’s game status. Subjects
also shared resources as part of the task, by drawing from the same pool of tiles and
discardng for their partners.

The recorded verbal exchange supported examination of the collaborative portion
of the game for establishing common meeting places. This information provided insight
into how subjects’ interaction differed across the conditions. We examined verbal
measures in regards to the use of spatial references. For this purpose, we examined the difference in usage of *a* and *the*, the usage of *this* and *that*, and *there* and *here* in pronoun form.

Manipulations

The above section addressed constant properties of the task for each pair of participants. The experiment incorporated the traditional experimental psychology methodology involving experimental manipulations, the effects of which were measured by dependent variables. Overall, the task consisted of experimental manipulations of color and adjacency and a subject variable of gender, along with theoretically driven constant task properties involving physical persistence, resource sharing, and collaboration.

The manipulations concerned the integration of constraints within the planning representation itself or separately, in a supplementary map. Specifically, we explored whether these low level cognitive properties would have an effect at the high level of collaborative planning.

*Plane travel.* Color-coding constrained plane travel only. In one condition the country color only appeared on the map of Africa, whereas in the other condition the color appeared on the country tiles themselves.

*Car travel.* Spatial relationships, specifically adjacency, constrained car travel. In one condition, spatial relationships only appeared on the map of Africa, whereas in the other condition the countries reachable by car appeared on each tile as an adjacency Text.

The purpose of the Color and the Text manipulations was to influence the emergence and the explicitness of the relationship between the countries and the
resources. Both manipulations were motivated by Zhang and Norman’s (1994) argument that characteristics of physical representations determine the amount of internal processing required for reasoning. In our study, we expected the explicitness of Color and Text to facilitate performance by reducing internal processing. Thus, color coding both country and resource tiles constrained their usage, in that like colors could only be used with other like colors. The color manipulations were motivated by Treisman and Gelade’s Feature Integration Theory in that the usage of color in the planning representation itself should result in reduced attentional and cognitive demand, as color is a feature. Text, on the other hand, is not a feature and involves cognitive processing.

Both manipulations influenced the explicitness of constraints required in the task. In the conditions with the presence of either Color and/or Text, the constraints were explicitly represented. For example using Color, one can only use a blue airplane to travel to a blue country, and so forth. However, in the non-color coded conditions, constraints resided in the map only and thus were more difficult to derive. Zhang and Norman (1994) argued that keeping constraints in memory is more taxing on cognitive resources rather than if they are emergent in the representation. Thus, we expected the subjects in the explicitly represented constraints conditions to experience less cognitive demand.

We believed that by varying the amount of explicit information and thus, by enriching the planning representation, we provided subjects with readily available information that may not need to be made explicit verbally during the planning process on the collaborative level. We believed that providing more information would facilitate performance (Tufte, 1990). However, we were interested in exploring the degree of facilitation. Thus, the way in which the constraint information was represented (Color
versus Text) may influence the planning process and performance. Specifically, both Color and Text are ways of representing constraints explicitly. However, Text does not have the status as a feature and is a more complicated object-like manipulation.

*Gender.* In addition to experimentally manipulated variables, gender was also used as a subject variable. Research from the organizational domain suggests that gender differences exist in workplace attitudes, reactions, expectations, etc. (Lefkowitz, 1994; Narayan & Steele-Johnson, 2007). Flynn and Ames (2006) suggest that, consistent with gender stereotypes, men tend to be more assertive, controlling, and confident than women. To avoid males consistently taking a dominant role over females, we implemented same-gender dyads.

**Pilot Work**

Pilot work was conducted in order to examine performance, collaboration, and resource management in a qualitative manner. Initially, pilot work was conducted with a physical version of the game for the Color/Text condition. In order to obtain insight into strategies, conversation between players and thinking aloud was encouraged. The number of resources (airplanes and cars) was varied in order to examine how their availability impacted game difficulty, collaboration, and time to completion. Initial findings suggested that smaller number of resources increased game difficulty, marked by willingness to change strategy and negotiation of resource sharing between players. All the proposed modified game properties listed above are the result of extensive piloting efforts.

Further pilot work was conducted with three pairs of subjects with a computerized version of the game in order to obtain quantitative data to conduct a power analysis. The
computerized pilot contained ten airplane tiles: two per color, and five automobile tiles (as the original version of the *10 Days in Africa Game*). Again, these limited resources resulted in difficulties in game completion and reinforced the idea of adding additional resources.

Pilot study results were reviewed to form the basis of a power calculation. We used the standard deviation of average response times and proportions for the participants in the pilot work to estimate Within Group Error. We used the maximum mean difference between conditions to estimate effect size. Kirk (1995, p. 487) was used to calculate the appropriate number of subjects. This calculation is displayed in Appendix A. The proposed sample size of twelve pairs per condition was adequate for examining main effects and the interaction of Color by Text with pairs of subjects.

Finally, additional pilot work was conducted in order to determine an optimal start-up card configuration/order that was standard across all teams. Multiple teams across experimental conditions participated in this pilot work. Based on the results, a configuration was selected and additionally modified in order to ensure the possibility of both; establishing common meeting places and completing the game. This configuration was further tested to ensure that the task could be accomplished across all conditions.

Hypotheses

In general, we believed that the Color and Text manipulations appearing on the tiles would aid performance. We believed that Color would facilitate performance on this team task. In addition, we also believed that Text would reduce cognitive load as it is an explicit representation of constraints. However, Text is different from Color in that it is not a feature and is a less direct way of representing constraints. Improved performance
might be evidenced by decreased time to completion, and number of draws and moves, as
well as in verbal measures and in the amount and the type of information shared. Most
importantly, these results would inform how manipulations that are cognitively relevant
to individual performance, support team activities. Specifically, the hypotheses were as
follows:

- **H1**: Manipulations that are relevant to individual performance aid
collaborative activity
  - **H1a**: Presence of Color coding will aid performance on this
distributed task
    - Evidenced in decreased time to completion, number of
draws, etc. and a difference in verbal measures
  - **H1b**: Presence of Text will aid performance
    - Evidenced in decreased time to completion, number of
draws, etc. and a difference in verbal measures
- **H2**: The presence of Color and Text will determine amount of verbal
  information shared

**Participants**

Forty-eight pairs from the undergraduate subject pool from Wright State
University participated in the experiment in same-sex pairs. They were recruited via the
computerized SONA system for experiment participation. Subjects received three
experimental credits for participating.

**Materials**

Subjects filled out a demographics questionnaire including items for Age, Gender,
Year, GPA, Work Experience, Travel Experience and Length of Trip. Appendix B
contains a sample of the demographics questionnaire.

Subjects interacted with a modified computer-based graphical version of the *10
Day in Africa* game described earlier. Specifically, game cards (country cards and
resource cards) appeared on a computer screen. Subjects had shared visual access to each
other’s planning representations as well as resource cards to be shared. Please see
Appendix C for the display that the subjects saw at the beginning of the game, organized by condition. Subjects also had a colored copy of the map of Africa, as represented in Appendix D.

Each subject used a 15-inch screen, HP laptop computer and a mouse. A Java program hosted on the computers recorded time stamps and the identity of the tiles moved throughout the task. The data output files were in Microsoft Excel, with a single file being outputted per individual player. In addition, software called River Past recorded video screen capture and audio of the subjects’ activities and verbal interactions throughout the task.

Design

The resulting design was a 2 (Color) x 2 (Adjacency Text) x 2 (Gender) factorial design. More specifically, constraints appeared as part of the planning representation versus separately. Thus, Color coding either appeared on the tiles and the map, or just on the map. Similarly, adjacency Text appeared on the tiles and emerged on the map, or just on the map. Half of the teams were Female and half of the teams were Male.

Procedure

Subjects were asked to sign a consent form and fill out the demographics questionnaire; and then they received instructions for seating and usage of the equipment. Specifically, subjects sat across the table from one another, each in front of their own computer screen with the computerized version of the 10 Days in Africa game. They were also given a physical (color-coded) map of Africa.

Subjects received written and verbal instructions for the task from the experimenter (see Appendix E). The instructions specifically mentioned that plane and
car tiles are limited in their availability. Subjects read the instructions on their own and then the experimenter read the instructions and elaborated on them. Subsequently, subjects received a training session by interacting with a practice version of the game. All teams received the same version of a pre-determined practice game. The training session differed only according to experimental manipulations associated with their condition. The experimenter asked the participants to think aloud about potential steps that can be taken throughout the practice game. The subjects practiced a series of pre-determined moves (after generating several possibilities) in order to learn how the display functions (i.e., how to move the cards, how to take turns, how to compile and indicate meeting places, and how to determine when the game is complete, etc.). Specifically, the rigged practice game allowed the subjects to win after taking a number of pre-determined moves.

For the actual game, subjects played the game until completion. Subjects were instructed that the object of the game was for one player to win. However, they were also given a competing goal of accomplishing the most efficient completion time across all teams. Subjects were told that if they were the most efficient team, they would receive a prize. Once one of the subjects verbalized that they were finished, the experimenter debriefed and dismissed the team.

Dependent Measures and Analyses

Performance measures reflected team (rather than individual) level performance. They were not the average of the two players; but rather a compilation of all activities conducted by the two players (which is what constitutes a game). The dependent variables included Completion Time, Number of Moves, Time between Moves, Number of Draws, Time between Draws, Unknown Pile Draws, Time between Unknown Pile
Draws, Known Pile Draws, Time between Known Pile Draws, and proportion of Planes versus Cars selected by subjects (transportation selection). In addition, demographic measures of Age, Gender, Year, and GPA were also collected, as well, 5-point Likert scale measures of Work Experience, Travel Experience and Length of Trip (with 5 being the maximum response).

The qualitative data in relation to meeting place establishment were analyzed as well. A subset of videos was chosen based on quantitative results. The portion of the videos when players were establishing their meeting place was transcribed in each of the chosen videos. In addition, textual analyses were performed on the verbal protocol that was captured as the subjects were playing the game. This included counts for the frequency of occurrence of relative pronouns of *there* and *here*.

In addition, state-space representations were created for the transcribed portions. They included the problem initial state, goal state (including meeting places), and the moves that were made from one step to another (Newell & Simon, 1972). Specifically, the identity of each card that was moved for the purpose of meeting place establishment was determined based on a number of parameters: name, color, entrance, exit, or connector. The origins of the cards were also identified as selection from a pile of Known tiles, selection from a pile of Unknown tiles, and selecting from partner. These representations were used in assistance with, as well as in complement to the aforementioned dependent measures.
III. RESULTS

Overview

The Results section first discusses the preliminary data processing, coding, and correlation analyses. Then it addresses analyses with the quantitative outcome measures, such as time to completion. Next, the section provides results using quantitative process measures, as they provide insight into the activities that subjects took part in throughout the game and the strategies that they employed. The section concludes with the analyses of qualitative process measures, such as language that provided insight into the collaborative aspects of the game. The analyses included contrasts to compare the difference between the three conditions that represented constraints versus the one condition that did not represent any constraints, by $t$-tests. The effects on DVs were analyzed with 2 (Color) x 2 (Text) x 2 (Gender) between-subjects Analyses of Variance (ANOVAs). Demographic measures were correlated with the DVs and explored as covariates in a series of Analyses of Covariance (ANCOVAs).

Preliminary Data Processing and Analyses

Data Processing

The timing between the two players was manually synchronized. The computer timing program created an asynchrony between Player 1 and Player 2. The offset recovered from the video provided a correction for Player 2’s time. The data were recoded to make the first move (made by either player) be at Time = 0. The time stamps for Player 1 and Player 2 were combined and sorted in chronological order of alternating moves made in the game.
The raw quantitative data in the output files provided a number of dependent variables. These measures provided insight into the outcome (Completion Time and proportion of Planes versus Cars selected by subjects) and the process (Number of Moves, Time between Moves, Number of Draws, Time between Draws, Unknown Pile Draws, Time between Unknown Pile Draws, Known Pile Draws, Time between Known Pile Draws, and language).

Coding Methods

The previously established definition of a completed game was when one player has completed his/her sequence and both players have common meeting places established. In four of the teams, at the time that one player completed his/her sequence, the other player did not yet have matching meeting locations. Thus, initially these teams were coded in two ways: based on when one player is finished, without matching meeting places; based on when one player is finished and both players have matching meeting places. All DVs were coded and analyzed with ANOVAs using these two methods; yielding similar results. As consistent with the original definition and based on the results; we report the DVs coded for both players having matching meeting places, when one player is finished. All subsequently described analyses employed the data that were coded based on this definition.

Correlations of Demographic Variables with the Dependent Variables

Table 1 contains the descriptive statistics of the demographic variables (Age, Gender, Year, and GPA) and the 5-point Likert scale measures (Work Experience, Travel Experience and Length of Trip). In order to capture the demographic measures at the team level, an average of the two players was taken for each of the variables (called
Average). Also, the demographic measures of the player of each team that won (called Won), were also examined. Table 2 contains the correlation matrix of the Average and Won demographic measures with the un-transformed DVs. The significant correlations are indicated on the matrices.

Additional correlation analyses were conducted with the expected (to be discussed in a later section) transformation of the DVs of Unknown Pile Draws SQRT, Time between Known Pile Draws SQRT, Time between Moves SQRT, and Number of Draws SQRT. Correlation analyses revealed a significant correlation between Number of Draws SQRT and Age Won at $r(48) = -.32, p < .05$. Also, these analyses indicated significant correlations between Unknown Pile Draws SQRT and Age of Won at $r(48) = -.32, p < .05$ and Work Experience of Won at $r(48) = -.29, p < .05$. Table 3 contains the complete correlation matrix.

Quantitative Outcome Measures

Outcome measures of the game concern the solution of the game. These include Completion Time and the types of meeting places employed in the solution. The results showed that both were aided by the manipulation of Color.

Completion Time

Completion time (in minutes) was defined as the time at which one of the players had completed their sequence and both players had matching meeting places. In order to determine the effect of representing constraints, a $t$-test compared the three conditions with represented constraints versus the one condition without (No Color/No Text). A significant difference was found at $t(46) = -2.80, p < .01$, with a shorter Completion Time
for the three conditions with constraints ($M = 9.89, SE = .97$) than the No Color/No Text condition ($M = 15.50, SE = 1.90$).

A three-way (Color x Text x Gender) between-subjects ANOVA was conducted with Completion Time (min) as the DV. Completion Time (min) resulted in a main effect of Color at $F(1, 40) = 16.74, p < .01$, Adjusted $R^2 = .24$. Specifically, the presence of color halved the Completion Time on the task, as represented in Figure 3. With an effect size of $\eta^2 = .27$; Color accounted for 27% of the variance in Completion Time. Table 4 and Table 5 include descriptive statistics and the ANOVA table, respectively.

**Number of Meeting Places Containing Cars Versus Planes**

Chi-squared tests examined the effect of the independent variables on the choice of meeting place vehicle, under the expectation that color in the planning representation

![Figure 3](Image)
would support plane travel whereas Text would support car, $\chi^2(1, N = 48) = 5.78, p < .05$ using a Fisher’s exact referent. Table 6 contains the Chi-Square counts, which suggest that subjects were more likely to pursue the Plane solution in the presence of Color, as also represented in Figure 4. Table 7 contains the Chi-Square test, which indicates the significance level. In general, color affected outcome.

Quantitative Process Measures

A number of quantitative process measures indicated the subjects’ activities throughout the game. The DVs of Number of Moves and Number of Draws resulted in main effects of Color. Number of Draws and Time Between Draws (ms) also yielded some significant interactions, to be reviewed below. Table 8 summarizes all significant effects. The DVs of Time Between Moves (ms), Unknown Pile Draws, and Time

![Graph showing Number of Planes versus Cars used as a function of Color.](image)

*Figure 4.* Number of Planes versus Cars used as a function of Color.
Between Known Pile Draws (ms) resulted violations of homogeneity of variance (marked in gray); and Time Between Unknown Pile Draws (ms) and Known Pile Draws did not yield significant results.

Distributions were examined for the dependent variables whose original models violated homogeneity of variance: Time Between Moves (ms), Unknown Pile Draws, and Time Between Known Pile Draws (ms). This was done for Number of Draws as well. These DVs (except for Time Between Moves) resulted in positively skewed, rather than normal distributions. As we had no a priori reason to expect linear scaling for these DVs, a square root transformation was conducted. According to Cohen et al. (2003), square root transformations are frequently used for count variables (number of draws qualifies as count variables) that yield a positively skewed distribution. Such a transformation results in equalization of variance, reduction of skew, and linearization the relationships to other variables. According to Winer et al. (1991), an acceptable reason to conduct a transformation is to obtain normality.

Three-way (Color x Text x Gender) between-subjects ANOVAs were conducted for the measures mentioned above. Time Between Known Pile Draws (ms) SQRT did not yield any significant results. Time Between Moves (ms) SQRT resulted in a violation of homogeneity of variance.

Below is a description of significant results with the DVs of Number of Moves, Number of Draws, Time Between Draws, and Unknown Pile Draws.

**Number of Moves**

Number of Moves included a count of every instance that either player moved a card to any location from any location; including draws and discards. Subjects frequently
moved cards in their own space, as a way to organize them. In order to determine the effect of representing constraints, a t-test was conducted to compare the three conditions with constraints versus the one condition without (No Color/No Text). No significant difference was found.

Three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Number of Moves. Number of Moves resulted in a main effect of Color at $F(1, 40) = 9.52$, $p < .01$, Adjusted $R^2 = .07$. Specifically, the presence of Color ($M = 102.04$, $SE = 8.78$) yielded smaller Number of Moves than the absence of Color ($M = 143.46$, $SE = 10.66$). Table 9 and Table 10 include descriptive statistics and the ANOVA table, respectively.

**Time Between Moves**

Time Between Moves (ms) was calculated from beginning of one move to the beginning of the next move (moves were previously defined). Three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Time Between Moves (ms). The ANOVA for Time Between Moves (ms) resulted in a violation of homogeneity of variance. This measure yielded a positively skewed distribution. ANOVA using the data corrected with a square root transformation yielded results that also violated homogeneity of variance (ANOVA shown in Table 11).

**Number of Draws**

Number of Draws was calculated as the number of instances that either player drew a new card from any of the three face-up or face-down piles. In order to determine the effect of representing constraints, a t-test was conducted to compare the three conditions with constraints versus the one condition without (No Color/No Text). A significant difference was found at $t(46) = -2.06$, $p < .05$, with less draws taken for the
three conditions with constraints \((M = 17.22, SE = 1.94)\) than the No Color/No Text condition \((M = 25.92, SE = 4.43)\).

Three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Number of Draws. Number of Draws yielded a Text x Gender interaction \(F(1, 40) = 6.72, p < .05, \text{Adjusted } R^2 = .19\) and a main effect of Color at \(F(1, 40) = 6.22, p < .05\). Specifically, in the Text condition, the Females made a greater Number of Draws than the Males.

This measure yielded a positively skewed distribution and was therefore, transformed. Number of Draws SQRT resulted in the Text x Gender interaction at \(F(1, 40) = 7.40, p < .05\) and a Color main effect at \(F(1, 40) = 8.40, p < .05\) with an overall Adjusted \(R^2 = .23\). As above, in the Text conditions, the Females drew more cards than the Males, as represented in Figure 5. Table 12 contains the ANOVA table for this model.

**Time Between Draws**

Time Between Draws (ms) was calculated from beginning of one draw to the beginning of the next draw. This measure indicated the frequency of acquiring new cards. In order to determine the effect of representing constraints, a \(t\)-test was conducted to compare the three conditions with constraints versus the one condition without (No Color/No Text). No significant difference was found. Three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Time Between Draws (ms). Time Between Draws (ms) yielded a Color x Text x Gender interaction at \(F(1, 40) = 4.35, p < .05, \text{Adjusted } R^2 = .08\). Figure 6 represents Time Between Draws (ms) as a function of Text. There is no difference between Males and Females at the Color condition. However, in Figure 7, which represents the No Color condition, there is a difference between genders.
Figure 5. Total Number of Draws SQRT as a function of Text and Gender.

Figure 6. Time Between Draws (ms) as a function of Text and Gender at Color only.
Specifically, in the absence of Color, Males take more time between draws when the Text is present, whereas Females take less time in this condition. Table 13 and Table 14 include descriptive statistics and the ANOVA table, respectively. The current measure did not yield a skewed distribution and was not transformed.

*Unknown Pile Draws*

Unknown Pile Draws was calculated as the number of instances that either player drew a new card from the face-down pile. In order to determine the effect of representing constraints, a $t$-test was conducted to compare the three conditions with constraints versus the one condition without (No Color/No Text). A significant difference was found at $t(46) = -2.23, p < .05$, with less draws taken for the three conditions with constraints ($M = 11.33, SE =1.66$) than the No Color/No Text condition ($M = 18.67, SE = 2.76$).
A three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Unknown Pile Draws. Unknown Pile Draws yielded a violation of homogeneity of variance. This measure was transformed as it yielded a positively skewed distribution.

Unknown Pile Draws SQRT resulted in Text x Color and Text x Gender interactions at $F(1, 40) = 5.00, p < .05$ and $F(1, 40) = 6.23, p < .05$, respectively. Specifically, in the No Text conditions, the absence of Color resulted in more cards drawn from the Unknown Pile as represented in Figure 8. Additionally, in the Text conditions, the Females drew more cards from the Unknown Pile, than the Males, as represented in Figure 9. The analysis also yielded a Color main effect at $F(1, 40) = 9.21, p < .01$ with an overall $R^2 = .26$ for the entire model. Table 15 contains the ANOVA table for this model.

**Time Between Unknown Pile Draws**

Time Between Unknown Pile Draws (ms) was calculated from beginning of any draw to the beginning of the next face-down pile draw. Three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Time Between Unknown Pile Draws (ms). The ANOVA did not yield any significant results, with the ANOVA reported in Table 16.

**Known Pile Draws**

Known Pile Draws was calculated as the number of instances that either player drew a new card from any of the three face-up piles. Three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Known Pile Draws. Number of Draws from Known Pile did not yield any significant results, with ANOVA reported in Table 17.
Figure 8. Number of Draws from Unknown Pile SQRT as a function of Text and Color.

Figure 9. Number of Draws from Unknown Pile SQRT as a function of Text and Gender.
*Time Between Known Pile Draws*

Time Between Known Pile Draws (ms) was calculated from beginning of any draw to the beginning of the next face-up pile draw. Three-way (Color x Text x Gender) between-subjects ANOVA was conducted for Time Between Known Pile Draws (ms). The ANOVA resulted in a violation of homogeneity of variance. This measure yielded a positively skewed distribution. The square root transformation also yielded results that were not significant as reported in Table 18.

*Analyses of Covariance*

The significant correlations (previously discussed) suggested that covariates should be examined further. ANCOVAs were conducted with significantly correlated demographic measures as covariates in the previously-discussed models that include the IVs. However, none of the demographic variables contributed significantly to the models.

ANCOVAs were conducted with significantly correlated demographic measures as covariates in the previously-discussed models that include the IVs. Specifically, an ANCOVA was conducted for Unknown Pile Draws SQRT as the DV and Age of Won and Work Experience of Won as covariates. The covariates were not found to be significant in this model. Thus, the model that does not include the covariates, but just the original IVs represents the data adequately.

A series of ANCOVAs were conducted to explore whether Age of Won contributes significantly to the model of Number of Draws SQRT as the DV. Age of Won did not make a significant contribution to these models as explored in various combinations. The model that does not include this covariate has the same adjusted $R^2$ as
the model without it. Thus, the model that does not include Age of Won, but just the
original IVs, represents the data adequately.

Collaboration Captured by Qualitative Process Measures

As multiple DVs resulted in Color main effects, we further explored decisions
made about Color as a collaborative process, in the audio/videos of the subjects
performing the task. Specifically, we explored whether subjects fixated on Color (rather
than adjacency) at the outset of the game. We defined this measure to be the occurrence
of conversation about the color of cards and matching by color; supported by physical
moves of the discussed cards. An example of such language is as follows: “01:13: P2:
Right, or unless we get something else yellow in common before you get that” for a
Female in the Color/No Text condition. If these events occurred in the first two minutes
of the game, the team was coded as exhibiting Color Fixation. All videos were coded for
Color Fixation by a single coder twice, separated by a length of time, to ensure reliability
(yielding the same results). Color fixation is collaborative because both players have to
agree on proceeding in a certain way.

Chi-Square analyses tested all interactions of Color Fixation and the IVs. Fixation
was dependent on the Text variable at $\chi^2(1, N = 48) = 4.46, p < .05$ (Table 19). The
effects were broken down to explore the levels more specifically. We first explored the
relationship of Text/Gender (at four levels) and Color Fixation, which was significant at
$\chi^2(3, N = 48) = 12.66, p < .01$ (Table 20). We further parsed down these effects by
examining Text and No Text in separate analyses. A significant interaction was found for
Text (Text present)//Gender by Color Fixation at $\chi^2(1, N = 48) = 6.00, p < .05$ (Table 21).
Table 22 contains the tallies for the significant conditions. Specifically, Females
exhibited Color Fixation less frequently than Males in the Text conditions, as represented in Figure 10. No such difference was found in the No Text conditions. The Chi-Square analyses on Color and Text by Color Fixation did not yield any significant results.

**Relationship Between Taking the First Move and Winning.**

Information of whether the first move was made by Player 1 or Player 2 and which of the players won was also coded. This measure was explored in order to investigate the relationship between the player that took the first move and his/her likelihood of winning (whether that player had an advantage). Chi-square analysis explored the relationship between First and Won. No significant results were found, suggesting that there was no relationship between moving first and winning. This idea confirms the game set-up in which subjects were not instructed on who needs to make the

![Figure 10. Color Fixation Proportion as a function of Text and Gender.](image-url)
first move. In other words, it did not matter who made the first move.

Collaboration Captured by Content Analyses

Qualitative analyses focused on the collaborative aspect of the task. Specifically, they addressed the process of determining and physically compiling the meeting places between the two players. This is an aspect of the task that was not captured by the quantitative analyses.

A subset of videos was chosen for transcription. As the IVs in the study were Color, Text, and Gender, we sampled a Car and a Plane solution from each of the eight conditions. However, the Color/No Text condition for both Males and Females did not contain any Car meeting places. Therefore, we sampled one Plane solution from each. The selection of exchanges for transcription were chosen by meeting place, in order to un-confound the position of the meeting place from the video selected. The resulting subset included a total of fourteen videos.

Textual Analyses

The portion of the videos related to the meeting place establishment was transcribed in each of the chosen videos. See Appendix F for the transcribed material organized by condition, with moves productive towards meeting place establishment in bold. Specifically, all spoken material was transcribed and time-stamped, along with the physical moves of cards involved in meeting place establishment.

The transcripts were examined to determine the frequency of occurrence of relative pronouns. Specifically, the words in question included: *a* versus *the; this* and *that*; as well as *there* and *here*; with only the latter showing a pattern of results. The occurrence of each word in each transcript was tallied. A three-way ANOVA was
conducted for the difference between *a* and *the* as a proportion of the total number of words in each transcript. No significant results were found. A three-way ANOVA was conducted for the sum of *this* and *that* as a proportion of the total number of words in each transcript. No significant results were found.

A three-way ANOVA was conducted for the sum of *there* and *here* as a proportion of the total number of words in each transcript. The absence of within cell variance in one condition precluded a homogeneity of variance test. The data did not a form a skewed distribution. Therefore no transformation was necessary. However, the model showed evidence of significant Text x Gender interaction, and Text and Gender main effects. A two-way (Text x Gender) ANOVA was conducted by eliminating the effect of Color from the model, as it was not significant in the previous analysis. This analysis yielded significant Text x Gender interaction at $F(1, 13) = 15.02, p < .01$, Text main effect at $F(1, 13) = 12.71, p < .01$, and Gender main effect at $F(1, 13) = 10.76, p < .01$. Specifically, Males in the Text condition used the words *there* and *here*, more frequently than subjects in other conditions, as represented in Figure 11. Table 23 and Table 24 include descriptive statistics and an ANOVA table for the discussed results. An example of context in which *there* was used is: “01:07: P1 - Yeah, that’s what you need right *there*” for a Male in the Color/Text condition and “00:51: P1 - …Libya to Niger. Over *there* on the uh, on the draw pile” for a Male in the No Color/Text condition. Instances of *here*, were fewer and include the following example by a Male in the Color/Text condition: “00:31: P1 - Niger right *here* in the face up.”

In addition to the above-discussed analyses, state-space representations were created for each of the transcripts. The state-space representations did not contribute to
Figure 11. *There* and *Here* Proportions as function of Text and Gender.

The analysis of game processes. The state-space representations captured all card moves that were directly relevant to the meeting places. The moves included any of the cards moved intended by the user to be used as part of a meeting place, as supported by the verbal protocol. The state-space representations consisted of nine types of information. Specifically, the state-space consisted of Initial State, referring to whether or not and to what extent each player has meeting places set up. The state space representation identifies which player is making each move (Player), which card is being moved (Object Name), color of the card (Object Color). Also, it is identified where the card originated (Object Origin) and where the card is being moved to (Object Destination); by ID of the spot and whether the locations are Known Piles, Unknown Pile, or free-play area. Object Role identifies whether the card was an Entrance (first of the triad of cards), an Exit (last
in the triad of cards), or a Connector (a plane or card connecting the two countries.

Resulting State refers to whether or not and to what extent each player has meeting places set up after the completion of the move in question. Lastly, Status is marked by Complete if a player has a completed set of meeting places. State-space representations were used to examine the number of moves made that were productive to meeting place establishment and how much the players utilized the free-play sections of the game board. Further examination of these measures did not provide evidence for any patterns. Appendix G contains all of the representations.
IV. DISCUSSION

Review of Hypotheses

The current study addressed the explicitness of representing constraints in a display that is used for the process of human planning on a team level. The following hypotheses were proposed as part of the current study:

- **H1**: Manipulations that are relevant to individual performance aid collaborative activity
  - H1a: Presence of Color coding will aid performance on this distributed task
    - Evidenced in decreased time to completion, number of draws, etc. and a difference in verbal measures
  - H1b: Presence of Text will aid performance
    - Evidenced in decreased time to completion, number of draws, etc. and a difference in verbal measures
- **H2**: The presence of Color and Text will determine amount of verbal information shared

In general, the data support these hypotheses. We found that incorporating constraints in planning representations is helpful in planning. However, a more complex pattern of results emerged that was not anticipated by these predictions. This discussion will address how the ways in which constraints are represented results in differing performance.

Constraints Incorporated into Planning Representations Help

The following section addresses how constraints that were incorporated into the planning representation influence performance. Two explanations for this finding are reduced cognitive load and opportunism.

The manipulations in the current study made the constraints of the planning activities more or less explicit in the representation itself. Overall, we found that representing constraints affects performance. Comparison of the three conditions that
included explicit constraints with the sole condition that did not, revealed benefits to several measures: shorter Completion Time and less Draws, specifically from the Unknown pile for the conditions with represented constraints. We believe that at the highest degree of uncertainty with the absence of both Color and Text, subjects resorted to a strategy of drawing more new cards and thus, creating new opportunities.

The results are consistent with two explanations for the advantages of constraints in representations. First, the results are consistent with Zhang and Norman’s (1994) argument that external representation of information is less cognitively demanding than internal (mental) representation. We found that low level cognitive manipulations do influence collaborative process and performance. Identical information was present across conditions in the planning representation and the map, however, it was more explicit when constraints appeared in the planning representation. This resulted in different processes and less cognitive effort to retrieve the given information. Such findings are predicted by the problem isomorph and informational equivalence literature, which suggests that the way in which information is presented influences reasoning about it (Bauer & Johnson-Laird, 1997; Larkin & Simon, 1987).

The results are also consistent with a second and rather different explanation. The representation of constraints enhances the salience of various solution opportunities. For example, if a player has two pink countries, the appearance of a pink plane provides an opportunity for connection that might be less salient if the country colors were missing. This idea is supported by the result that in the presence of Color, teams almost always chose a Plane as part of their meeting places. This suggests that subjects took an opportunistic strategy to planning. Specifically, opportunities emerged as a function of
game progression and became grouped or organized together, supported with the representation of Color.

Not All Representations of Constraints are Equal

Some of the human factors literature suggests that the juxtaposition of any relevant information should enhance performance (Tufte, 1990). Color and Text were different ways of representing constraints of the task. Indeed, the results hinged upon how the information was represented. We found a different pattern of results for representing travel constraints via Color versus via Text.

Influence of Color on the Planning Performance

We found that the presence of Color resulted in Completion Time that was almost twice as fast, on a scale of minutes. The literature in visual search (Treisman & Gelade, 1980; Treisman, 1998; Wolfe, 1994) employed visual search tasks where subjects had to search for colored targets among distracters. The reaction times in such studies were measured on the order of milliseconds and therefore, orders of magnitude shorter than our study. The literature in human factors examined use of color in display design on the order of seconds (Van Laar & Deshe, 2007). Our finding is consistent with Treisman and Gelade’s (1980) research on color as a feature of representations that facilitates efficient visual search, however, in the present study at a much larger time scale.

Color in particular may be promoting chunking. Specifically, the usage of Planes in the meeting locations allows for the chunk of three cards to emerge based on Color as a semantic grouping. In other words, Color represents relationships between different types of tiles, effectively reducing the memory load from three items to one item, and establishing the completion of a task subgoal.
**Influence of Color on the Planning Process**

As suggested above, during the planning process itself, Color directs attention to current opportunities. Without Color, subjects had to acquire and construct opportunities more actively. One way to increase opportunities for goal achievement is acquiring new cards by drawing. Another way to increase opportunities is by reorganizing cards that a subject already has. The presence of Color reduced the number of instances of both of these activities. Specifically, it reduced the Number of Draws, specifically from the Unknown Pile, suggesting that participants made use of the existing resources. The presence of Color also resulted in a smaller Number of Moves; suggesting less interim organizing of cards. Participants apparently perceived useful arrangements more readily, and left them in place. This has beneficial implications for real-world activities, where checking for alternatives may be costly in terms of time.

**Influence of Text on the Planning Process**

Text influences the planning process in a different manner. As described above, in the absence of salient opportunities, subjects must be more active in creating them. Results indicate that in the No Text/No Color conditions, more cards were drawn; especially from the Unknown Pile, than in the presence of Color. There was no difference found in the card draws in the Text conditions. We believe that with the absence of both Color and Text, subjects attempted to create new opportunities because they did not notice the current opportunities as readily.

Gender effects suggest that features of the planning representation influence Males and Females differently. Females changed their strategy depending on the presence of the Text. This is evidenced in a more opportunistic strategies implemented by
Females in response to Text. In the No Color/Text condition, the Females took less Time between Draws than Males. In addition, in the Text conditions, the Females drew more cards from the Unknown Pile, than the Males. This finding is also consistent with the verbal measure of Color Fixation interaction. Specifically, Females exhibited Color Fixation less frequently than Males in the Text conditions. In general, all of these results suggest that the presence of Text resulted in a Female (but not Male) strategy of seeking new opportunities by drawing more cards and drawing more frequently. Consistent with the research on opportunistic planning, in that opportunities from the environment drive planning (Hayes-Roth & Hayes-Roth, 1979; Hammond, 1990; Siefert & Patalano, 2001).

Males changed their language in response to the Text variable, specifically the use of *there* and *here*. As subjects always had shared visual access, they could always use spatial references with confidence that their partners understood the referent. However, Males in the Text condition used the words *there* and *here* more frequently than subjects in all other conditions. There was no such effect of Text versus No Text for Females. This result suggests that Male pairs were better synchronized with a Text than without a Text. Overall, the pattern of results consistently shows that Males and Females respond differently to the presence of the Text, affecting both the solution strategy and the coherence of the team. Interestingly, such gender differences do not show up in the cognitive and human factors psychology literature. In a review of multiple meta-analyses, Hyde (2005) found that males and females are similar on most psychological variables related to aptitude.

In general, the nature of the task allowed for the emergence of strategies that provided insight into human planning. In the absence of salient opportunities, subjects
adapted by searching for new opportunities. In our study, subjects exhibited adaptive behavior by taking the opportunistic planning approach. Interestingly, the outcome measure of Completion Time does not distinguish between the two strategies.

Effects of Task Properties

This section identifies constant task properties that likely influenced the pattern of results, as limitations or advantages.

*Limitations of Task Properties*

There are at two limiting properties of task to be discussed below. The first limitation involves the absence of a value system placed on the resources to evaluate solution quality. For example, if the cost of using a Plane was higher than using a Car, it would allow for an evaluation criterion for usage of one versus the other. A value system would allow for an assessment of expenditures throughout the game as a measure of solution quality. In other words, with the presence of a value system, we might have seen more effects on an outcome. This limitation further precludes an important test of the influence of low level variables on high level cognition. For example, if plane travel were costly, would the color manipulation still dominate solutions?

Second, this study did not address plan execution. Specifically, the current task addressed the activities of hypothetical reasoning and not real-time performance. We believe that in order to achieve a smooth execution, we need to understand how to optimize the planning processes such as addressed in the current study. Future research could go a step further to evaluate plan quality based on its. This would provide an opportunity to address the usage of the same representation for a different task.
Advantages of Constant Task Properties

Collaboration. A vital aspect of our results is that manipulations that are relevant to individual performance did influence collaborative team processes. Historically, both in cognitive and human factors psychology, the effects of such manipulations are only examined on an individual level. This study suggests that we have some basis for generalizing individual performance to group processes in distributed and collaborative settings.

Physical persistence. Across all conditions, all elements continued to persist in the representation after being acted upon. This allowed subjects to have a great deal of visibility of the status of some of the tiles (available or in use, etc.) that were shared between them. For instance, subjects could see that the cards in each player’s sequence are in use and the cards in the Known piles are available. Subjects also likely had some recollection of the tiles that had been covered up in the Known piles. However, the status of the cards in face-down pile was in fact truly unknown, until acted upon. For every draw, each player had a choice of selecting a card that they knew the status of (taking advantage of the physical persistence) versus a card whose status was not visually available (rejecting the physical persistence and selecting something that is unknown). Interestingly, the lack of significant findings for the Known pile draws, suggests that subjects did take advantage of the information that physical persistence had to offer. Specifically, by using the Unknown pile to acquire new cards, they were rejecting the cards that were easily available. Thus, the physical persistence guided decision making behavior. On the other hand, if we did not have an Unknown pile in our game or if all the cards were face-down, then we would not have been able to detect such a pattern of
behavior. In those cases, the measure of drawing new cards would not have provided insight into subjects’ strategies.

Resource management. The current task involved a pool of resources that both subjects could access. The resources were scarce in that there was a limited number of both Cars and Planes. Subjects were notified of this limitation in the task instructions. This resulted in subjects holding on to the transportation tiles that they drew. Their decision making process was thus influenced by the knowledge that resources might be difficult to obtain or they might even run out. This was particularly evident with Cars. Thus, the apparent availability of resources impacted the subjects’ strategies.

Planning. Traditional cognitive psychology problem solving tasks such as Tower of Hanoi are limited in emergent properties and solution options (Simon & Hayes, 1976; Zhang & Norman, 1994). Our task had the characteristics of ill-defined problem, where the end state is not as well defined (Reitman, 1964). It involved a larger search space (a more varies set of objects) and therefore, more options of possible combinations for legal solutions. Specifically, this structure was emergent as a function of the experimental manipulations that guided the search for opportunities and marked the completion of subtasks. For example, Color created an emergent feature associated with a completed plan element, specific to planning representations. Thus, the completed subtasks facilitated the planning process by promoting certain solution options. Finally, the larger search space may have allowed for different strategies of either using current opportunities or actively searching for new opportunities. Tasks that are smaller in scope of options favor only a limited number of solutions.
Conclusions

Primarily, this study is a contribution to the limited number of studies that addresses the process of human planning (Day, 1988; Hammond, 1990; Hayes-Roth & Hayes-Roth, 1979), where we found that representations influence planning strategies. Consistent with the hypotheses, the results of the current study demonstrated that explicitly represented constraints do influence the planning process and performance. However, the pattern of results was more complex and interesting than anticipated. In particular, the representation of constraints via Color versus via Text influenced Male and Female strategies differently. In other words, these results suggest that customized displays may be advantageous in real-world applications to optimize reasoning strategies.

Secondly, our study both supplements and complements the traditional human factors research. Unlike HF, this study addressed hypothetical reasoning and not real-time performance of control tasks. Similarly to some HF literature, we determined that the way in which information is presented influences behavioral strategies (Wickens & Carswell, 1995). However, in this case, the emergent features mapped onto the completion of task subgoals.
Table 1
Descriptive Statistics of Demographic Variables

<table>
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<th>Variable</th>
<th>Range</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SE</th>
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<tr>
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<td>31.00</td>
<td>18.85</td>
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<td>3.00</td>
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$N = 48$
Table 2
Correlations of Won and Average Demographic Variables

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<th>Comp Time (min)</th>
<th>Num Moves</th>
<th>Unknown Pile</th>
<th>Known Pile</th>
<th>Num Draws</th>
<th>Time btw Moves (ms)</th>
<th>Time btw Draws (ms)</th>
<th>Time btw Unknown (ms)</th>
<th>Time btw Known (ms)</th>
</tr>
</thead>
<tbody>
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<td>Age Won</td>
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<td>-0.23</td>
<td>-0.29*</td>
<td>-0.17</td>
<td>-0.29*</td>
<td>-0.33*</td>
<td>-0.08</td>
<td>-0.05</td>
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<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.02</td>
<td>0.11</td>
<td>0.04</td>
<td>0.23</td>
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<td>0.02</td>
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<td>0.73</td>
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<td></td>
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Table 2 (continued)
Correlations of Won and Average Demographic Variables

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*p < .05. **p < .01.
Table 3
Correlations of Won and Average Demographic Variables with DV SQRT

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Correlations of Won and Average Demographic Variables with DV SQRT

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*p < .05. **p < .01.
Table 4
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$SE$ are reported in parentheses

$n = 6$
Table 5
Analysis of Variance for Completion Time (min)

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<td>0.96</td>
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<td>0.96</td>
<td>0.03</td>
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</tr>
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<td>TEXT * GENDER</td>
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<td>0.35</td>
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</tr>
</tbody>
</table>

*p < .05. **p < .01.

*R Squared = .351 (Adjusted R Squared = .237)
Table 6
Chi-Square Counts for Color x Car/Plane

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<tr>
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<th>Plane</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>2</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>No Color</td>
<td>9</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>37</td>
<td>48</td>
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</tbody>
</table>
Table 7
Chi-Square Test for Color x Car/Plane

<table>
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<tr>
<th></th>
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<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>5.78</td>
<td>1</td>
<td>0.02</td>
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<td></td>
</tr>
<tr>
<td>Continuity Correction</td>
<td>4.25</td>
<td>1</td>
<td>0.04</td>
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<td></td>
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<td>Likelihood Ratio</td>
<td>6.15</td>
<td>1</td>
<td>0.01</td>
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<tr>
<td>Fisher's Exact Test</td>
<td></td>
<td></td>
<td>0.04</td>
<td>0.02 **</td>
<td></td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>48.00</td>
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</table>

*p < .05. **p < .01.
### Table 8
Summary of Significant Results for Quantitative DVs

<table>
<thead>
<tr>
<th>Effects</th>
<th>Completion Time</th>
<th>Num Moves</th>
<th>Time btw Moves</th>
<th>Num Draws</th>
<th>Num Draws SQRT</th>
<th>Time btw Draws</th>
<th>Time btw Unknown Pile Draws</th>
<th>Time btw Known Pile Draws</th>
<th>Time btw Known Pile Draws SQRT</th>
<th>Color Fixation</th>
<th>There / Here</th>
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</thead>
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<td>**</td>
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<td>*</td>
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<td></td>
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</tr>
<tr>
<td>Text</td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Color x Text</td>
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<td>Color x Gender</td>
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<tr>
<td>Text x Gender</td>
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<td>Color x Text x Gender</td>
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</tbody>
</table>

* *p < .05  
** **p < .01
Table 9
Means and Standard Errors for Number of Moves

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Text Total</th>
<th>No Text Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Text</td>
<td>97.50</td>
<td>135.83</td>
<td>116.67</td>
<td>127.83</td>
<td>117.67</td>
</tr>
<tr>
<td>(12.22) (19.72)</td>
<td></td>
<td></td>
<td>(12.48) (9.94)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8.78) No Text</td>
<td>87.00</td>
<td>87.83</td>
<td>87.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(16.04) (17.42)</td>
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<td></td>
<td>(11.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Color Text</td>
<td>113.50</td>
<td>164.50</td>
<td>139.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(21.69) (17.39)</td>
<td></td>
<td></td>
<td>(15.32)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10.66) No Text</td>
<td>156.83</td>
<td>139.00</td>
<td>147.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(22.92) (22.02)</td>
<td></td>
<td></td>
<td>(15.39)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>113.71</td>
<td>131.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10.35) (10.67)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SE are reported in parentheses

n = 6
Table 10
Analysis of Variance for Number of Moves

<table>
<thead>
<tr>
<th>Source</th>
<th>Type I SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>39362.00</td>
<td>7</td>
<td>5623.14</td>
<td>2.60</td>
<td>0.03</td>
</tr>
<tr>
<td>Intercept</td>
<td>723243.00</td>
<td>1</td>
<td>723243.00</td>
<td>334.61</td>
<td>0.00</td>
</tr>
<tr>
<td>COLOR</td>
<td>20584.08</td>
<td>1</td>
<td>20584.08</td>
<td>9.52</td>
<td>*</td>
</tr>
<tr>
<td>TEXT</td>
<td>1240.33</td>
<td>1</td>
<td>1240.33</td>
<td>0.57</td>
<td>0.45</td>
</tr>
<tr>
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<td>3924.08</td>
<td>1.82</td>
<td>0.19</td>
</tr>
<tr>
<td>COLOR * TEXT</td>
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<td>4370.08</td>
<td>2.02</td>
<td>0.16</td>
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<tr>
<td>COLOR * GENDER</td>
<td>27.00</td>
<td>1</td>
<td>27.00</td>
<td>0.01</td>
<td>0.91</td>
</tr>
<tr>
<td>TEXT * GENDER</td>
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<td>8480.08</td>
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<td>2161.43</td>
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<tr>
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<tr>
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</tr>
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*p < .05. **p < .01.

R Squared = .313 (Adjusted R Squared = .193)
Table 11
Analysis of Variance for Time Between Moves SQRT

This analysis violated homogeneity of variance

<table>
<thead>
<tr>
<th>Source</th>
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<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>1506.54</td>
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<td>215.22</td>
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</tr>
<tr>
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<td>248336.43</td>
<td>1948.51</td>
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<td>COLOR</td>
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<td>1</td>
<td>848.91</td>
<td>6.66</td>
<td>* 0.01</td>
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<td>61.80</td>
<td>1</td>
<td>61.80</td>
<td>0.48</td>
<td>0.49</td>
</tr>
<tr>
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<td>235.09</td>
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<td>COLOR * LIST</td>
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<td>58.23</td>
<td>0.46</td>
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<tr>
<td>COLOR * GENDER</td>
<td>4.20</td>
<td>1</td>
<td>4.20</td>
<td>0.03</td>
<td>0.86</td>
</tr>
<tr>
<td>LIST * GENDER</td>
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<td>7.22</td>
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<td>0.81</td>
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</table>

*p < .05. **p < .01.

R Squared = .228 (Adjusted R Squared = .093)
Table 12
Analysis of Variance for Number of Draws SQRT

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<th>p</th>
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<tbody>
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<td>4.33</td>
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<td>0.01</td>
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<td>842.40</td>
<td>577.97</td>
<td>0.00</td>
</tr>
<tr>
<td>COLOR</td>
<td>12.24</td>
<td>1</td>
<td>12.24</td>
<td>8.40 **</td>
<td>0.01</td>
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<td>0.24</td>
<td>0.63</td>
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<td>1</td>
<td>2.19</td>
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<td>0.23</td>
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<td>3.98</td>
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<td>0.11</td>
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<td>0.32</td>
<td>0.22</td>
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</tr>
<tr>
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<td>10.78</td>
<td>1</td>
<td>10.78</td>
<td>7.40 **</td>
<td>0.01</td>
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<td>0.44</td>
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<tr>
<td>Error</td>
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<td>1.46</td>
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</table>

*p < .05. **p < .01.

*R Squared = .342 (Adjusted R Squared = .227)
Table 13
Means and Standard Errors for Time Between Draws (ms)

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Text Total</th>
<th>No Text Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text</td>
<td>43042.28</td>
<td>36124.22</td>
<td>39583.25</td>
<td>39150.72</td>
<td>37342.855</td>
</tr>
<tr>
<td>(2949.79)</td>
<td>(4880.01)</td>
<td>(7109.85)</td>
<td>(4241.31)</td>
<td>(2994.62)</td>
<td>(2611.98)</td>
</tr>
<tr>
<td>No Text</td>
<td>41016.61</td>
<td>33218.19</td>
<td>37117.40</td>
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<td>(2949.79)</td>
<td>(7241.68)</td>
<td>(4605.82)</td>
<td>(4257.00)</td>
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<tr>
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<tr>
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<td>(3611.28)</td>
<td>(5682.35)</td>
<td>(4413.47)</td>
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<td>(2675.63)</td>
<td>(2713.59)</td>
<td>(5227.81)</td>
<td>(3224.73)</td>
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</tbody>
</table>

Total          | 41283.40 | 35210.17 |          |             |               |
|                | (2602.20)| (2878.88)|           |             |               |

SE are reported in parentheses

n = 6
### Table 14
Analysis of Variance for Time Between Draws (ms)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type I SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
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<td>273439399.53</td>
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</tr>
<tr>
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</tr>
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<td>514563.20</td>
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<td>0.63</td>
</tr>
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<td>5195416.28</td>
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<td>0.86</td>
</tr>
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<td>0.74</td>
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<td>662937873.94</td>
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<td>743784116.73</td>
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<td>* 0.043</td>
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<td>171032979.12</td>
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</tr>
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</table>

*R Squared = .219 (Adjusted R Squared = .082)*

*p < .05. **p < .01.
### Table 15
Analysis of Variance for Number of Unknown Pile Draws SQRT

<table>
<thead>
<tr>
<th>Source</th>
<th>Type I SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
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</thead>
<tbody>
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<td>Corrected Model</td>
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<td>7</td>
<td>4.49</td>
<td>3.31</td>
<td>0.01</td>
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<tr>
<td>Intercept</td>
<td>546.28</td>
<td>1</td>
<td>546.28</td>
<td>402.34</td>
<td>0.00</td>
</tr>
<tr>
<td>COLOR</td>
<td>12.50</td>
<td>1</td>
<td>12.50</td>
<td>9.21 **</td>
<td>0.00</td>
</tr>
<tr>
<td>TEXT</td>
<td>0.38</td>
<td>1</td>
<td>0.38</td>
<td>0.28</td>
<td>0.60</td>
</tr>
<tr>
<td>GENDER</td>
<td>2.32</td>
<td>1</td>
<td>2.32</td>
<td>1.71</td>
<td>0.20</td>
</tr>
<tr>
<td>COLOR * TEXT</td>
<td>6.78</td>
<td>1</td>
<td>6.78</td>
<td>5.00 *</td>
<td>0.03</td>
</tr>
<tr>
<td>COLOR * GENDER</td>
<td>0.74</td>
<td>1</td>
<td>0.74</td>
<td>0.54</td>
<td>0.47</td>
</tr>
<tr>
<td>TEXT * GENDER</td>
<td>8.46</td>
<td>1</td>
<td>8.46</td>
<td>6.23 *</td>
<td>0.02</td>
</tr>
<tr>
<td>COLOR * TEXT * GENDER</td>
<td>0.24</td>
<td>1</td>
<td>0.24</td>
<td>0.17</td>
<td>0.68</td>
</tr>
<tr>
<td>Error</td>
<td>54.31</td>
<td>40</td>
<td>1.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>632.00</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>85.72</td>
<td>47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.

*R Squared = .366 (Adjusted R Squared = .256)
Table 16
Analysis of Variance for Time Between Unknown Pile Draws (ms)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type I SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>3483919871.93</td>
<td>7</td>
<td>497702838.85</td>
<td>1.83</td>
<td>0.11</td>
</tr>
<tr>
<td>Intercept</td>
<td>74392043689.75</td>
<td>1</td>
<td>74392043689.75</td>
<td>273.16</td>
<td>0.00</td>
</tr>
<tr>
<td>COLOR</td>
<td>7804663.28</td>
<td>1</td>
<td>7804663.28</td>
<td>0.03</td>
<td>0.87</td>
</tr>
<tr>
<td>LIST</td>
<td>280574849.87</td>
<td>1</td>
<td>280574849.87</td>
<td>1.03</td>
<td>0.32</td>
</tr>
<tr>
<td>GENDER</td>
<td>880918764.26</td>
<td>1</td>
<td>880918764.26</td>
<td>3.23</td>
<td>0.08</td>
</tr>
<tr>
<td>COLOR * LIST</td>
<td>328118922.95</td>
<td>1</td>
<td>328118922.95</td>
<td>1.20</td>
<td>0.28</td>
</tr>
<tr>
<td>COLOR * GENDER</td>
<td>146599656.58</td>
<td>1</td>
<td>146599656.58</td>
<td>0.54</td>
<td>0.47</td>
</tr>
<tr>
<td>LIST * GENDER</td>
<td>1036869319.24</td>
<td>1</td>
<td>1036869319.24</td>
<td>3.81</td>
<td>0.06</td>
</tr>
<tr>
<td>COLOR * LIST * GENDER</td>
<td>803033695.76</td>
<td>1</td>
<td>803033695.76</td>
<td>2.95</td>
<td>0.09</td>
</tr>
<tr>
<td>Error</td>
<td>10893403728.37</td>
<td>40</td>
<td>272335093.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>88769367290.05</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>14377323600.30</td>
<td>47</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*R Squared = .242 (Adjusted R Squared = .110)
Table 17
Analysis of Variance for Known Pile Draws

<table>
<thead>
<tr>
<th>Source</th>
<th>Type I SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>157.65</td>
<td>7</td>
<td>22.52</td>
<td>1.06</td>
<td>0.41</td>
</tr>
<tr>
<td>Intercept</td>
<td>1862.52</td>
<td>1</td>
<td>1862.52</td>
<td>87.56</td>
<td>0.00</td>
</tr>
<tr>
<td>COLOR</td>
<td>63.02</td>
<td>1</td>
<td>63.02</td>
<td>2.96</td>
<td>0.09</td>
</tr>
<tr>
<td>LIST</td>
<td>0.52</td>
<td>1</td>
<td>0.52</td>
<td>0.02</td>
<td>0.88</td>
</tr>
<tr>
<td>GENDER</td>
<td>2.52</td>
<td>1</td>
<td>2.52</td>
<td>0.12</td>
<td>0.73</td>
</tr>
<tr>
<td>COLOR * LIST</td>
<td>0.02</td>
<td>1</td>
<td>0.02</td>
<td>0.00</td>
<td>0.98</td>
</tr>
<tr>
<td>COLOR * GENDER</td>
<td>1.02</td>
<td>1</td>
<td>1.02</td>
<td>0.05</td>
<td>0.83</td>
</tr>
<tr>
<td>LIST * GENDER</td>
<td>77.52</td>
<td>1</td>
<td>77.52</td>
<td>3.64</td>
<td>0.06</td>
</tr>
<tr>
<td>COLOR * LIST * GENDER</td>
<td>13.02</td>
<td>1</td>
<td>13.02</td>
<td>0.61</td>
<td>0.44</td>
</tr>
<tr>
<td>Error</td>
<td>850.83</td>
<td>40</td>
<td>21.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2871.00</td>
<td>48</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1008.48</td>
<td>47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.

R Squared = .156 (Adjusted R Squared = .009)
Table 18
Analysis of Variance for Time Between Known Pile Draws SQRT (ms)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type I SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>11104.11</td>
<td>7</td>
<td>1586.30</td>
<td>0.81</td>
<td>0.58</td>
</tr>
<tr>
<td>Intercept</td>
<td>1728180.39</td>
<td>1</td>
<td>1728180.39</td>
<td>886.07</td>
<td>0.00</td>
</tr>
<tr>
<td>COLOR</td>
<td>48.00</td>
<td>1</td>
<td>48.00</td>
<td>0.02</td>
<td>0.88</td>
</tr>
<tr>
<td>LIST</td>
<td>833.68</td>
<td>1</td>
<td>833.68</td>
<td>0.43</td>
<td>0.52</td>
</tr>
<tr>
<td>GENDER</td>
<td>845.17</td>
<td>1</td>
<td>845.17</td>
<td>0.43</td>
<td>0.51</td>
</tr>
<tr>
<td>COLOR * LIST</td>
<td>7441.18</td>
<td>1</td>
<td>7441.18</td>
<td>3.82</td>
<td>0.06</td>
</tr>
<tr>
<td>COLOR * GENDER</td>
<td>291.61</td>
<td>1</td>
<td>291.61</td>
<td>0.15</td>
<td>0.70</td>
</tr>
<tr>
<td>LIST * GENDER</td>
<td>498.31</td>
<td>1</td>
<td>498.31</td>
<td>0.26</td>
<td>0.62</td>
</tr>
<tr>
<td>COLOR * LIST * GENDER</td>
<td>1146.16</td>
<td>1</td>
<td>1146.16</td>
<td>0.59</td>
<td>0.45</td>
</tr>
<tr>
<td>Error</td>
<td>78015.58</td>
<td>40</td>
<td>1950.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1817300.09</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>89119.69</td>
<td>47</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.

R Squared = .125 (Adjusted R Squared = -.029)
Table 19
Chi-Square Test for Text x Color Fixation

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>4.46</td>
<td>1</td>
<td>0.03</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Continuity Correction</td>
<td>3.28</td>
<td>1</td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>4.56</td>
<td>1</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher's Exact Test</td>
<td></td>
<td></td>
<td></td>
<td>0.07</td>
<td>0.03</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 20
Chi-Square Test for Text/Gender x Color Fixation

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>12.66</td>
<td>3</td>
<td>0.01 **</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>13.25</td>
<td>3</td>
<td>0.00</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.
Table 21
Chi-Square Test for Text only/Gender x Color Fixation

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>6.00</td>
<td>1</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity Correction</td>
<td>4.17</td>
<td>1</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>6.28</td>
<td>1</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher's Exact Test</td>
<td></td>
<td></td>
<td></td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*< .05. **< .01.
Table 22
Chi-Square Counts for Text/Gender x Color Fixation

<table>
<thead>
<tr>
<th></th>
<th>Color Fixation</th>
<th>No Color Fixation</th>
<th>Proportion</th>
<th>Proportion</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text</td>
<td>Male</td>
<td>3</td>
<td>9</td>
<td>.25</td>
<td>.75</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>9</td>
<td>3</td>
<td>.75</td>
<td>.25</td>
</tr>
<tr>
<td>No Text</td>
<td>Male</td>
<td>11</td>
<td>1</td>
<td>.92</td>
<td>.08</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>8</td>
<td>4</td>
<td>.67</td>
<td>.33</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>31</td>
<td>17</td>
<td>.65</td>
<td>.35</td>
</tr>
</tbody>
</table>
Table 23
Means and Standard Errors for *There & Here* Proportion

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text</td>
<td>0.0226</td>
<td>0.0028</td>
<td>0.0127</td>
</tr>
<tr>
<td></td>
<td>(0.0029)</td>
<td>(0.0012)</td>
<td></td>
</tr>
<tr>
<td>No Text</td>
<td>0.0036</td>
<td>0.0044</td>
<td>0.0040</td>
</tr>
<tr>
<td></td>
<td>(0.0036)</td>
<td>(0.0027)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.0131</td>
<td>0.0036</td>
<td></td>
</tr>
</tbody>
</table>

*SE* are reported in parentheses

*N* = 14
Table 24
Analysis of Variance for *There & Here* Proportion

<table>
<thead>
<tr>
<th>Source</th>
<th>Type I SS</th>
<th>$df$</th>
<th>$MS$</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>0.00</td>
<td>3</td>
<td>0.00</td>
<td>14.37</td>
<td>0.00</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.00</td>
<td>1</td>
<td>0.00</td>
<td>39.78</td>
<td>0.00</td>
</tr>
<tr>
<td>TEXT</td>
<td>0.00</td>
<td>1</td>
<td>0.00</td>
<td>10.76</td>
<td>**0.01</td>
</tr>
<tr>
<td>GENDER</td>
<td>0.00</td>
<td>1</td>
<td>0.00</td>
<td>12.71</td>
<td>**0.01</td>
</tr>
<tr>
<td>TEXT * GENDER</td>
<td>0.00</td>
<td>1</td>
<td>0.00</td>
<td>15.02</td>
<td>**0.00</td>
</tr>
<tr>
<td>Error</td>
<td>0.00</td>
<td>10</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.00</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>0.00</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05.* **$p < .01.$

*R Squared = .812 (Adjusted R Squared = .755)*
Appendix A: Power Analysis (after Kirk, 1995, p. 487)

\[ n \text{ (Number of subjects per pair)} = 2 \]
\[ p \text{ (Number of levels of (we are treating 2x2 as a 1-way with 4 levels for the power analysis)} = 4 \]
\[ q \text{ (Pairs within AB)} = 12 \]

Results of the pilot data collection informed the below calculations.

The below formula pertains to the detection of difference in proportion of airplanes versus cars used in the game.

\[
\hat{\phi}_\lambda = \sqrt{\frac{\hat{\lambda}_{AB}}{p}} = \sqrt{\frac{\sum_1^p \alpha \beta^2_j}{p} \sqrt{\frac{\hat{\sigma}_{\varepsilon}^2}{nq(\mu)}}} = \sqrt{\frac{.15^2 / 4}{.04 / (2 \times 12)}} = 1.84
\]

We are considering the proportion of .15 (airplanes versus cars) to be significant.

The below formula pertains to the detection of difference in response time.

\[
\hat{\phi}_\lambda = \sqrt{\frac{\hat{\lambda}_{AB}}{p}} = \sqrt{\frac{\sum_1^p \alpha \beta^2_j}{\rho} \sqrt{\frac{\hat{\sigma}_{\varepsilon}^2}{nq(\mu)}}} = \sqrt{\frac{15^2 / 4}{1.44 / (2 \times 12)}} = 30.62
\]

We are considering a difference of 15 sec (per step) to be significant.
Appendix B: Demographics Questionnaire

TRIP PLANNING IN AFRICA

Please fill in the information below to the best of your ability

Age: _____________

Gender: Male ___  Female ___

Major: _____________

Year in School (please circle): Freshman  Sophomore  Junior  Senior  Graduate

GPA (if 1st semester freshman, please report high-school GPA): _____________

Work Experience (full-time/part-time and including military experience) (please circle):

None  Less than 1 year  1 to 2 years  2 to 3 years  Greater than 3 years

Please describe what type of work experience:
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Travel Experience (including local and international trips) (please circle):

I Do Not Travel  I Travel Rarely  I Travel Sometimes  I Travel Regularly  I Travel a Lot

Length of Average Trip (please circle):

1 Day  Weekend  1 Week  1 Month  More than 1 month

Please describe what type of travel experience:
_________________________________________________________________________
_________________________________________________________________________
                                                                                     


Appendix C: Game Display at Start-up

**Condition: Color/Text**

![Game Display Diagram](image)

**Condition: Color/No Text**

![Game Display Diagram](image)
**Condition: No Color/Text**

<table>
<thead>
<tr>
<th>Libya</th>
<th>Senegal</th>
<th>Central African Rep.</th>
<th>Botswana</th>
<th>Eswatini</th>
<th>Mauritania</th>
<th>Mali</th>
<th>Namibia</th>
</tr>
</thead>
</table>

**Condition: No Color/No Text**

<table>
<thead>
<tr>
<th>Libya</th>
<th>Senegal</th>
<th>Central African Rep.</th>
<th>Botswana</th>
<th>Eswatini</th>
<th>Mauritania</th>
<th>Mali</th>
<th>Namibia</th>
</tr>
</thead>
</table>

---

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Appendix D: Map of Africa
Appendix E: Task Instructions for Color/Text Condition

11 Days in Africa

OBJECTIVE

The object of this game is for each player to design an eleven day journey in the continent of Africa. You will visit six countries during this trip, and you will connect each country to the next destination with a day of travel using a specific type of transportation (airplane or car).

You must work with your partner to agree on a set of meeting places, involving the same departure country, the same transportation and the same destination country, on the same set of days in your eleven-day journeys.

You should try to complete your design before your partner, but you should also try to make sure that you and your partner together are efficient relative to the other teams that will play this game.

GAME PIECES

- Map of Africa: You can use the map to help you with your choices in the game. The map is color coded.

3 Types of Tiles: each tile constitutes a “Day”
- Country tiles are color coded and contain a list of country names
- Airplane tiles are color coded: You can fly from one country to another of the same color.
- Car tiles: You can drive between the countries that are next to one another on the map. Specifically, you can drive from on country to another country that appears on the list of the first country tile.

- 1 Draw pile (face-down): You draw from this pile.
- 3 Discard piles (face-up): You can discard and draw from this pile.

INSTRUCTIONS

You will be playing the game on the computer with your partner. You will be able to see what the other person is doing. The top section of the screen belongs to Player 1 and the bottom section of the screen belongs to Player 2. The row below Player 1 and the row above Player 2 belong to those players respectively. This is a free play area. You can arrange your cards in that area as you please. Placing cards in that area does not count as a turn and does not count towards the object of the game.
Your game will begin with a random sequence of tiles. You need to put them in the order that adheres to these rules:

1) You must include either an airplane or a car tile between each pair of country tiles. You cannot travel between two of the same countries.
2) You must start and end with a country tile.
3) You must take turns, and you may only take one turn at a time. You can draw a tile from either a draw pile or any of the 3 discard piles. You can replace a tile with the drawn tile or discard it in the discard pile. Drawing and discarding once constitutes a single turn.
4) You must always have exactly 11 cards (since you draw and then discard on every turn).
5) You must not go into the other person’s section and take their cards.
6) You must work with your partner to agree on a set of meeting places, involving the same departure country, the same transportation and the same destination country, on the same set of days in your eleven-day journeys.

You may trade and negotiate tiles by asking the other player to discard in the face-up pile.
Appendix F: Transcripts Organized by Condition
Color-Text
Male # 40
Meeting: Pink Niger / Pink Plane / Pink Senegal at the beginning

00:10 Experimenter: Ok, go ahead.
00:12 P1: Alright, do we wanna go with the first three?
00:14 P2: Yeah, we should try it.
00:15 P1: I see we both have Libya.
00:18 P2: Yeah. We also… There is a Niger you can get and you also have a purple airplane; we can do that.
00:28 P1: Ok, we’re gonna do that at the beginning then?
00:30 P2: So, let’s, yeah.
00:32 P1:
*** Moved pink Plane from self (5) to free-play
*** Moved pink Plane from free-play to free-play
*** Moved pink Plane from free-play to free-play again
00:32 P2: You can take the Niger from the draw pile.
00:35 P1:
*** Moved Car from self (0) to free-play (next to Niger)
*** Moved Car from free-play to free-play
*** Moved Car from free-play to free-play
*** Moved Car from free-play to free-play
*** Moved Car from free-play to self (5)
00:41 P2: We’ll put, we’ll put Niger first then.
00:42 P1:
*** Moves blue Plane from self (1) to free-play
*** Moves pink Plane from free-play to self (0)
*** Moves pink Plane from self (0) to self (1)
00:43 P2:
*** Moves pink Plane from self (54) to free-play
*** Moves green DR Congo from self (45) to free-play
00:45 P2:
*** Moves pink Plane from free-play to self (45)
*** Moves green DR Congo from free-play to free-play
00:50 P1:
*** Moves pink Niger from Known (30) to free play
*** Moves pink Niger from free-play to free-play (3 times)
*** Moves pink Niger from free-play to self (0)
00:50 P2: And then we’ll find another purple one.
00:55 P2: So, we need to get, I need to get the same purple one, so it’s my turn.
00:56 P1: Right.
00:58 P2: So, let, so let’s get rid of Ethiopia.
*** Moves orange Ethiopia from self (48) to Known (30)
*** Moves DR Congo from free-play to self (48)
*** Draws pink Senegal from Unknown (26) to free-play
01:07  P1: Yeah, that’s what you need right there.
01:10  P2:
***  Moves pink Senegal from free-play to free-play  
***  Moves yellow Plane from self (46) to free-play  
***  Moves pink Senegal from free-play to self (46)  

At this point, P2 has established a set of three meeting place of Pink Niger / Pink Plane / Pink Senegal at the beginning of his journey.

01:13  P1: Ok, my turn?
01:14  P2: Yeah.
01:15  P1:
***  Moves blue Plane from free-play to free-play  
***  Moves green Libya from self (2) to free-play  
***  Moves pink Senegal from self (3) to self (2)  

At this point, P1 has established a set of three meeting place of Pink Niger / Pink Plane / Pink Senegal at the beginning of his journey.

01:18  P1: Now, do I need to pull this down to the three-face?
01:22  P2: Yeah, you need to put one down.
01:23  P1:
***  Discards green Libya from free-play to Known (28)  
***  Moves blue Plane from free-play to free-play  
***  Moves blue Plane from free-play to self (3)  
01:27  P1: So, we got that.
01:28  P2: We’re done with that, so.

The game continues. No more conversation about the meeting places occur and no changes are made.

Summary
Players find that they have several pink cards in common, so they decide to set those up at the beginning of their journeys. P2 draws a pink Senegal on his first draw and that is the one that matches.
**Color-Text**
**Male # 28**
**Meeting: Yellow Mali / Car / Pink Niger at the end**

00:10  Experimenter: Ok, go ahead and start.
00:12  P2: Ok. What’s the three we got in common?
00:21  P1: We got Mali, Ethiopia
00:23  P2: Ethiopia, ah, we got a car.
00:30  <very muffled>
00:31  P1: Niger right here in the face up.
00:39  P2: Oh, I see.
00:43  P2: Let’s see here.
00:47  P1: I’m gonna go ahead and snag the Niger <unclear>
*** Moves green Botswana from self (6) to free-play
*** Draws pink Niger from Known (30) to self (6)
*** Discards green Botswana from free-play to Known (30)
00:59  P1: Alright.
01:05  P2: Let’s see here. Where do you wanna end? <Assumption that the meeting places have to be at the end?>
01:10  P1: Niger.
01:14  P2: Ok
*** Moves pink Niger from self (47) to free-play
*** Moves pink Plane from self (54) to self (47)
*** Moves pink Niger from free-play to self (54)
01:18  P2: Let’s see. Ok Niger. Mali. We could drive to Mali. I mean, you could drive to Niger from Mali.
01:33  P1: Ok
01:34  P2: Yeah.
*** Moves green Libya from self (53) to free-play
*** Moves yellow Mali from self (50) to self (53)
*** Moves yellow Mali from self (53) to self (50)
*** Moves Car from self (51) to self (53)
01:38  P1: Oh, I see that. Ok.
01:39  P2:
*** Moves yellow Angola from self (52) to self (51)
*** Moves yellow Mali from (50) to self (52)
01:44  P2: I guess, I’m <muffled>
01:45  P1: Hah?
01:46  P2: I think I gotta draw a card now.
*** Move green Libya from free-play to self (50)
*** Draw pink Senegal from Unknown (26) to free-play

*At this point, P2 established as set of meeting places of Yellow Mali / Car / Pink Niger at the end of his sequence.*

01:48  P2: Yeah. Who? You or me?
01:55  P1: You gotta draw a card.
01:58  P2: Ok.
02:10  P1: Then get rid of one.
02:12  P2: I’m gonna get rid of…
***   Discards DR Congo into Known (28)
***   Moves pink Senegal from free-play to self (48)
02:30  P1: Let’s see. We wanna do Niger…
***   Moves orange Namibia from self (10) to free-play
***   **Moves pink Niger from self (6) to self (10)**
02:33  P1: …so let me pull that down.
***   Moves orange Ethiopia from self (7) to self (6)
***   Moves blue Mauritania from self (8) to self (7)
02:35  P1: …from Mali. We can drive to Mali.
***   **Moves Car from self (0) to self (8)**
02:37  P2: Alright.
02:39  P1:
***   Moves orange Namibia from free-play to self (0)
***   **Moves Car from self (8) to free play**
02:43  P1: Ah, … pretty easy … <unclear>
***   **Moves yellow Mali from self (9) to self (8)**
***   **Moves Car from free-play to self (9)**
02:46  P2: Alright, there we go.
02:48  P1: Ok.

The game continues. Some more conversation about meeting places occurs later on.

05:15  P2: Are we only supposed to have three in a sequence?
05:19  P1: Yeah.
05:20  P2: Oh, ok. Mali, Niger, and …

At this point, P1 established as set of meeting places of Yellow Mali / Car / Pink Niger at the end of his sequence. The game continues and there is no more conversation about the meeting places.

Summary
Players examine what cards they have in common starting with yellow Mali. Then they see that they can drive (and they both have a car) from Mali to Niger. P2 already has Niger and P1 draws it from the face up pile.
**Color-Text**

**Female # 59**

**Meeting: Pink Senegal / Pink Plane / Pink Niger in the middle**

00:10 Experimenter: Ok, go ahead.
00:11 P1: So if you see something that I have next to each other, point it out to me and I’ll point it out to you.
00:12 P2: Ok.
00:13 P1: So, we’ll just like, help each other.
00:14 P2: Ok. Um. What do you wanna start with?
00:18 P1: Well, let’s look and see what we have first and see which ones line up.
01:08 P2:

*** Moves pink Niger from self (44) to free-play *** Moves DR Congo from self (45) to self (44)
01:10 P1: *** Moves green Botswana from self (6) to free-play ***
01:12 P2: *** Moves yellow Angola from self (52) to free-play ***
01:17 P1: *** Moves orange Namibia from self (10) to free-play ***
01:27 P2: *** Moves Car from self (0) to free-play ***
01:40 P2: Ok, at this point, the ones that we have that are the same are yellow and it’s Mali.
01:44 P1: Yeah, well we have um. No, no we don’t.
01:46 P2: Well, we also have Ethiopia, which is orange and we can both get Niger, which is pink.
01:51 P1: Yeah. We both have pink Planes too, so I would just need to get a purple one then. Do you wanna try that?
02:02 P2:

*** Moves DR Congo from self (44) to free-play ***

*** Moves pink Niger from free-play to self (44) ***
02:10 P2: Hang on, let me see what I have that’s next to each other. So you wanna do purple?
02:37 P1: Yeah, we can do purple. That’s fine.
02:40 P2: That’s fine. Alright.
02:41 P1: Do you have one that’s next to Niger?
02:44 P2: Uh…Yeah, I have Algeria.
02:50 P1: Ok, so I go first? Is that correct?
02:51 P2: Yeah, you can go first. Just moving my airplane.
*** Move pink Plane from self (54) to free-play
*** Move pink Plane from free-play to free-play
*** Move pink Plane from free-play to free-play
*** Move pink Plane from free-play to free-play
*** Moves yellow Plane from free-play to free-play
*** Move pink Plane from free-play to free-play
*** Move pink Plane from free-play to self (44)

02:55 P1: Ok, so I’m gonna take a pink. Um. I’m just gonna put it here for now, but we might end up moving that.

*** Draws pink Niger from Known (30) to free-play
*** Draws pink Niger from free-play to self (0)
*** Moves blue Plane from self (1) to free-play

03:04 P2: Ok

*** Moves pink Niger from self (44) to self (46)
*** Moves blue Burkina Faso from self (47) to free-play
*** Moves Car from self (51) to self (47)

03:04 P1:
*** Moves green Libya from self (2) to free-play
*** Moves pink Plane from self (5) to self (1)
*** Moves pink Senegal from self (3) to self (2)

03:09 P1: Actually, let’s put it in the middle because I have something that’s next to both of those. Is that ok?

03:09 P2:
*** Moves orange Ethiopia from self (48) to free-play
*** Moves orange Algeria from self (49) to free-play

03:12 P1:
*** Moves Central African Republic from self (4) to free-play

03:14 P2: That should be fine

*** Moves yellow Mali from self (50) to free-play

03:15 P1:
*** Moves pink Plane from self (1) to self (4)
*** Moves pink Senegal from self (2) to self (3)
*** Moves pink Niger from self (0) to self (5)

At this point, P1 have a set of meeting places of Pink Senegal / Pink Plane / Pink Niger established in the middle of her sequence.

03:19 P2:
*** Moves orange Algeria from self (49) to self (50)
*** Moves orange Algeria from self (50) to self (51)
*** Moves Car from self (47) to self (50)
*** Moves pink Niger from self (46) to self (48)
*** Moves pink Plane from self (45) to self (46)
*** Moves pink Plane from self (46) to self (47)

03:25 P1:
*** Moves orange Ethiopia from self (7) to free-play
03:25  P2:
***  Moves pink Niger from self (48) to self (49)
***  Moves pink Plane from self (47) to self (48)
03:29  P2: Ok.
03:30  P1: Ok, let me line these up really fast.
***  Makes 6 moves that are not productive toward meeting places
03:32  P2: Niger, Libya
***  Moves green Libya from self (53) to free-play
***  Moves orange Algeria from self (52) to self (53)
***  Moves Car from self (51) to self (52)
***  Moves pink Niger from self (49) to self (50)
***  Moves pink Plane from self (48) to self (49)
03:40  P1: Oups
03:47  P2: My turn?
03:48  P1: No, I have to discard.
03:49  P2: Ok.
03:51  P1: Do you want any of mine to help you?
03:52  P2: Ah, let me see. Angola. I can. <whispering> Ah, I’ll take you Central African one, unless you are using that one.
***  Moves yellow Mali from free-play to free-play
***  Moves yellow Mali from free-play to free-play
***  Makes 2 more moves
04:08  P1: I think I might, I don’t know. I might use my. Yeah, I think I’m gonna use this Central Africa one.
04:15  P2: Alright. Alright, that’s good. It doesn’t matter.
04:24  P1: How about my blue plane. You might use blue. Does that work for you?
04:27  P2: Yeah, that’s fine if you wanna give me your blue plane.
04:28  P1: Ok, your turn.
***  Discards blue Plane from free-play to Known (30)
04:32  P2: Ok, your turn.
***  Picks up blue Plane from Known (30) to free-play
04:33  P1: Did you discard?
04:35  P2: No, I need to figure out which one. I have yellow. I have blue. Ah, I’ll get rid of that one. Ok.
***  Discards green Libya from free-play to Known (30)
***  Moves blue Plane twice
***  Moves blue Burkina Faso
04:55  P1:
***  Picks up yellow Plane from Known (29) to self (1)
04:58  P1: Do you want my other blue one?
05:00  P2: Sure <laughing> That should work.
05:00  P1:
***  Discards blue Mauritania to Known (29)
05:01  P2: I’ll take that one and get rid of that one.
***  Picks up blue Mauritania from Known (29) to self (48)
***  Discards DR Congo from free-play to Known (29)
*** Makes 3 moves of blue cards in the sequence

05:05 P1: Ok, let me think. Let me take a minute to see what I have. <whispering> Libya, Botswana, what was I gonna do?

05:58 P1: Ok, how about? <whispering> I’m gonna draw one.

*** Draws pink Senegal from Unknown (26) to free-play

06:15 P1: Dang, I don’t need that one. Oh, but you need that one.

06:18 P2: Yeah, I’ll take that one if you want any of mine.

*** Moves yellow Angola from self (47) to free-play

06:24 P1:

*** Discards pink Senegal from free-play to Known (28)

06:28 P2: Let me get rid of all my yellow one

*** Makes 3 moves with yellows

06:29 P1: I think at this point all I need is transportation. Just don’t cover up the Demo…the green one in the middle, cause I might use that one.

06:33 P2: Alright

*** Picks up pink Senegal from Known (28) to free-play

*** Moves pink Senegal from free-play to self (48)

At this point, P2 established three meeting places of Pink Senegal / Pink Plane / Pink Niger at the middle of her sequence. The game continues and no more conversation about meeting places occurs and no changes are made.

Summary
The players do not set up meeting places at the outset. They first start moving a bunch of cards to try to figure out how to link the together. They later on identify that they have some pinks in common. P1 asks if they can put them in the middle because it works best for her. Several draws occur before they pick up the pink Senegal from the Unknown pile. At that point, they both are able to set up the meeting places. The above transcription is almost the entire game. They work on the meeting places as they are working on their own sequences, rather than setting up the meeting places first.
Color-Text
Female # 58
Meeting: pink Senegal / car / yellow Mali at the end

00:08 Experimenter: Ok, now.
00:13 P2: I think we should probably get the first three cards that we’re supposed to have similar, first.
00:16 P1: Ok. That’s Ethiopia
*** Moves orange Ethiopia from 7 down into free-play
00:24 P1: Mali
*** Moves yellow Mali from 9 down into free-play
00:26 P1: What else? We have, um.
00:29 P2: We could drive between those at the end.
00:31 P1: Ok, that sounds like a plan.
*** Moves Car from 0 down into free-play (between Ethiopia and Mali)
00:34 P1:
*** Moves orange Ethiopia from free-play to 7
*** Moves Car from free-play to 8
*** Moves yellow Mali from free-play to 10
*** Moves Car from 8 to 9
00:40 P1: Those are the only ones we have in common, I think.
00:41 P2: Ok
00:42: P1:
*** Moves orange Ethiopia from 7 to 8
00:44 P2: Oh wait, I think you still have a turn, cause I think you just, you just moved your own cards. I think you still have to…
00:47 P1: Pick up one?
00:50 P2: Pick up one and then discard one.
00:54
*** P1: Draws pink Senegal from Unknown (26) into free-play <discards green Botswana into Known (28)>
01:04 P1: Ok
*** Moves pink Senegal from free-play to 7
01:06 P1: I have two of them. Senegal. So, do you want one this one?
01:10 P2:
*** Moves pink Plane from self (54) to free-play
01:11 P1: I don’t know how to pronounce it <talking about Senegal>
01:13 P2: Oh, ah, hang on just a second. I might.
*** Moves yellow Mali from self (50) to 54
*** Moves car from self (51) to self (53)
*** Moves orange Ethiopia from self (48) to self (52)
01:45 P2: Hmmm. This is hard.
01:55 P2:
*** Discards green Libya into Known (30)
02:00 P2: I’m just gonna look at this.
*** Draws green Plane from Unknown (26) and places in free-play
P1: So, since I have two of these, I'll just put that down there.

*** Discards pink Senegal into Known (28)

P2: Ok. Thank you.

P1: You are welcome.

P2:

*** Picks up pink Senegal (that P1 discarded) from Known (28) and places in 51

Have three identical cards established at the end of orange Ethiopia / car / yellow Mali. However, one cannot drive between Ethiopia and Mali. This is not explicitly stated by the subjects. Approximately 5 draws (P1: 3 / P2: 2) occur.

P2: Maybe we can keep drawing until we got another card besides Ethiopia, since, none of us, since either of us, have any cards that borders it. We could try that. Is it your turn or my turn?

P1: I think it’s mine.

P1: Ok.

*** Draws orange Plane from Unknown (56)

P1: I’ll just discard that.

*** Discards pink Senegal into Known (28)

* P1 Places two orange cards in a row in free-play*

P2: And we probably, actually could have kept that.

P1: Which one?

P2: The Senegal.

P1: Yeah. I forgot we both have the same one.

P2: Ok, well, I’ll just leave that one open so you can pick it back up. And then I’ll discard that one <refers to orange Ethiopia>.

P2:

*** Moves orange Ethiopia from self (52) to self (51)

*** Moves pink Senegal from self (44) to 52

P2:

*** Discards orange Ethiopia from self (51) into Known (29)

P2: Ok. Or did I?

P1: No, you didn’t.

*** Picks up pink Senegal from Known (28) to self (3)

P2: I didn’t pick one up. Ok.

*** Discards blue Plane from free-play to Known (28)

P1: The airplane is underneath the Ethiopia.

P2: The what?

P1: The airplane, the pink airplane is underneath Ethiopia.

P2: Is that what I need?

P1: I don’t know. Yeah, I might need it. I’m not too sure yet. If I can find a border state.

P2:

*** Moves pink Plane from self (45) to self (51)
*** Draws pink Niger from Unknown (26) to free-play

08:10 P1:

*** Moves orange Namibia from self (6) to free-play

*** Moves pink Senegal from self (3) to self (6)

08:14 P1: Hang on.

*** Moves blue Mauritania from self (4) to self (3)

*** Moves Car from self (5) to self (4)

*** Moves pink Senegal from (6) to self (5)

*** Moves orange Namibia from free-play to self (6)

08:30 P2

*** <3 moves of green cards in the sequence area & 2 more of others>

08:37 P1:

*** Moves orange Ethiopia from self (8) to free-play

*** Moves pink Senegal from self (5) to self (8)

Meeting places are established as pink Senegal / Car / yellow Mali at the end. No explicit conversation about this achievement occurs. About 29 draws (P1: 15 / P2: 14) occur.

Summary

In summary, the subjects began be establishing three identical cards at the end of each sequence. It seemed like thought that it was a legal sequence. No conversation occurred about whether or not it was. They decided to change the meeting places when neither of them could locate cards to travel to orange Ethiopia from. P2 changed the sequence to begin with Senegal and P2 followed. No explicit conversation about this process occurred. Except that at some point P2 pointed out that P1 should keep the pink Senegal as they have that in common.

It seemed that maybe the players didn’t even notice that the first set of meeting places wasn’t legal and changed it because it seemed like they couldn’t match it up with the other cards that they were drawing.
Color-No Text
Male # 22
Meeting: pink Senegal / pink Plane / pink Niger at the end

00:11 Experimenter: Ok, you can begin
00:27 P1: Let’s see.
00:40 P1: You wanna do the pink?
00:46 P2: What do we have in common? <Seems like a rhetorical question to initiate thinking about commonalities>
P1: We can take Niger off the Text
00:51 P2: And you’ve got a plane
P1: And I’ve got a plane and that one <pointing to pink Senegal>. We can do it that way, if you want.
P2: That’s fine
01:00 P1: I don’t see any other easier way.
01:08
*** P1 picks up a pink Niger from Known (30) to self (8)
*** Moves pink Niger into self (10) (after creating an empty spot for it).
*** Moves pink Plane (that he already has) from self (5) to self (9) (after creating an empty spot for it)
*** Moves pink Senegal (that he already has) from self (3) to self (8)
01:15 P1: Alright, I’ve arranged these bad boys (very muffled)
01:16 – 01:25
*** P2 moves pink Plane (that he already has) from self (54) to free-play
*** Moves pink Niger (that he already has) from self (44) to self (54)
*** Moves pink Plane from free-play area to self (53)
01:25 P2: My turn?
P1: Yeah.
01:30
*** P2 draws pink Senegal from Unknown (26) to free-play
*** Places pink Senegal in 52

Meeting places of pink Senegal / pink Plane / pink Niger are established at the end of each player’s sequence at the beginning of the game with no changes. No further conversation about meeting places follows.
Color-No Text
Female # 56
Meeting: Pink Niger / Pink Plane / Pink Senegal in the middle

00:11  Experimenter: Ok, go ahead please.
00:15  P1: *** Makes 3 moves
00:20  P1: Well, do you wanna go ahead and get the three that we have to get together, together?
00:27  P2: Yeah.
00:28  P1: I see a Mali.
00:30  P2: We have Mali in common.
00:30  P1: Yeah.
00:31  P1: *** Moves Car from self (8) to free-play
00:31  P1: *** Moves yellow Mali from self (9) to self (8)
00:32  P1: You wanna just put that at the end like we did
00:31  P1: *** Moves car from self (51) to free-play
00:35  P2: Yeah
00:35  P1: *** Draws yellow Plane from Known (29) to self (9)
00:37  P2: *** Moves yellow Mali from self (50) to self (51)
00:37  P2: You said you …<muffled>
00:40  P1: I went first already so…
00:40  P2: *** Moves yellow Angola from self (52) to free-play
00:40  P2: *** Moves yellow Mali from self (51) to self (52)
00:43  P1: Alright
00:43  P1: I did discard.
00:55  P1: Hmm. I guess I’ll get rid of this one.
00:55  P1: *** Discards Central African Republic from self (4) to Known (29)
01:00  P2: *** Moves pink Plane from self (50) to free-play
01:01  P1: *** Moves Car from free-play to self (4)
01:02  P2: *** Moves Burkina Faso from self (47) to self (50)
01:05  P2: Ok, let me see.
01:07  P1: So, now I need Angolia.
01:13  P2: Right or unless we get something else yellow in common before you get that.
01:16  P1: Mhm.
01:20  P2: Alright, I’m gonna go ahead and draw, I guess.
***  Draws pink Senegal from Unknown (26) to free-play
***  Moves green Libya from self (45) to self (46)
***  Moves pink Plane from free-play to self (45)
***  Moves green Libya from self (46) to free-play
01:34  P1:
***  Moves pink Plane from self (5) to free-play
***  Moves Car from self (4) to self (5)
***  Moves pink Plane from free-play to self (4)
01:35  P2:
***  Moves pink Senegal from free-play to self (46)
01:38  P1:
***  Moves Car from self (5) to free-play
***  Moves green Botswana from self (6) to self (5)
***  Moves pink Plane from self (4) to self (6)
***  Moves green Botswana from self (5) to self (4)
***  Moves pink Senegal from self (3) to self (5)
***  Moves green Botswana from self (4) to self (3)
***  Moves Car from free-play to self (4)

At this point, the P1 is looking for a yellow Angola to complete their meeting places of Yellow Mali / Yellow Plane / Yellow Angola. They haven’t yet noticed the pink opportunities.

***  P2 makes 2 moves
****  P1 makes 8 moves

02:30  P2: Let me see what borders Senegal.
02:38  P2: Ok.
***  Moves Burkina Faso from self (50) to free-play
***  Moves pink Senegal from self (46) to self (50)
***  Moves orange Algeria from self (49) to self (47)
***  Moves pink Plane from self (45) to self (49)
***  Moves orange Ethiopia from self (48) to free-play
***  Moves pink Niger from self (44) to self (48)

At this point, P2 has three meeting places of Pink Niger / Pink Plane / Pink Senegal established at the beginning of her sequence.

02:55  P1: Well, we also have a Senegal and purple plane in common. And if we could just get... I have Nigeria, so I can get that one instead.
03:02  P2: Hold on, say it again. We got Senegal and the purple plane in common and you have...
03:07  P1: We have the purple sequence together.
03:11  P2: Oh, alright. So, you wanna go ahead and go with that one?
03:14  P1: Yeah, go with that one instead.
03:16  P2: Alright, that’s cool. So, alright, you want the Niger.
03:24  P1: Yeah, so did you already draw? Is it my turn now?
03:25  P2: No, not yet. I’m trying to figure out…let me see.
03:32  P1: Do you wanna put Senegal last and Niger first? Cause Niger is bigger so, we’ll be able to connect more things to it.
03:38  P2: You said Senegal first and Niger last?
03:40  P1: No, Niger first.
03:42  P2: Oh, Niger first and Senegal last. Like it is now?
*** Moves pink Senegal from self (50) to free-play
*** Moves pink Niger from self (48) to free-play
*** Moves pink Niger from free-play to self (48)
*** Moves pink Senegal from free-play to self (50)
03:46  P1: Yeah, but at the end of the sequence.
03:50  P2:
*** Moves Car from self (51) to free-play
*** Moves Car from free-play to self (51)
03:56  P1: Well, I guess we can put in the middle. Whatever works for you.
03:57  P2: Ok. Yeah, it works better in the middle for me.
03:59  P1: In the middle. Ok.
04:01  P2: Cause then I got the end of my trip. Alright.
*** Makes 7 moves and 1 draw
04:20  P2: Now, let me see what borders Niger that I have. Ok, it’s your turn.
*** Makes 3 moves and 1 discard
04:55  P1:
*** Moves blue Mauritania from self (4) to free-play
*** Moves orange Ethiopia from self (7) to self (4)
*** Moves orange Ethiopia from self (4) to free-play
*** Moves pink Senegal from self (5) to self (7)
*** Moves pink Plane from self (6) to self (5)
*** Draws pink Niger from Known (30) to self (4)
*** Moves pink Senegal from self (7) to self (6)

At this point, P1 has three meeting places of Pink Niger / Pink Plane / Pink Senegal established at the beginning of her sequence. The game continues. No more conversation about the meeting places occurs and no changes are made.

Summary
The players begin with trying to set up yellow meeting places at the end of their sequence. They are looking for a one more yellow card for P1 (Angola). As the game progresses, they notice that they have pinks in common. They decide to have the meeting places in the middle because that’s where P2 already has hers sets up and it works best for her.

106
**No Color-Text**

**Male # 42**

**Meeting: Pink Senegal / Pink Plane / Pink Niger in the middle**

00:12  Experimenter: Ok, go ahead.
00:25  P2:

*** Moves green Libya from self (53) to free-play
00:35  P2: I'll see what I can drive to.
00:36  P1: We can drive from ah...from Libya...Libya

*** Moves green Libya from self (2) to free-play
*** Moves Car from self (0) to free-play
00:44  P2:

*** Moves Car from self (53) to free-play
00:48  P1: Then you can pick up Niger.
00:50  P2: Which one?
00:51  P1: Libya to Niger. Over there on the uh, on the draw pile.
00:58  P1:

*** Picks up pink Niger from Known (30) to free-play (next to Libya and Car)
00:59  P2: You got it.

*** Moves pink Niger from self (44) to free-play (next to Car and Libya)
01:04  P1: Since, I picked up one, now I gotta get rid of one?
01:07  P2: Yeah.

*** Moves yellow Angola from self (52) to self (51)
*** Moves pink Plane from self (54) to self (44)
01:11  P1: I'll just get rid of that one for right now <referring to Ethiopia>

*** Discards orange Ethiopia from self (7) to Known (30)
01:13  P2: Where do you wanna put it? Do you wanna put it at the front or the end, or what?
01:15  P1: I'll just move it there

*** Moves pink Senegal from self (3) to self (2)
*** Moves yellow Central African Republic from self (4) to self (3)
*** Moves pink Plane from self (5) to self (4)
 *** Moves green Botswana from self (6) to self (5)
01:20  P2: Alright.
01:22  P1:

*** Moves blue Mauritania from self (8) to self (6)
 *** Moves yellow Mali from self (9) to self (7)
01:23  P2:

*** Moves pink Niger from free-play to self (54)
*** Moves Car from free-play to self (53)
*** Moves green Libya from free-play to self (52)
01:25  P1:

*** Moves Namibia from self (10) to self (8)
*** Moves pink Niger from free-play to free-play
*** Moves Car from free-play to free-play
*** Moves green Libya from free-play to free-play
01:31 P1: Alright. So, it’s my turn. Ah, let me see. Uhm.
*** Moves yellow Angola from self (51) to free-play
*** Draws pink Senegal from Unknown (26) to free-play
01:56 P2: I got purple. I could use…hmmm…
02:14 P2: Oh, we should flip this around. So Libya
*** Moves pink Niger from self (54) to free-play
*** Moves green Libya from self (52) to self (54)
*** Moves pink Niger from free-play to self (52)
02:18 P1:
*** Moves pink Niger from self (10) to free-play
02:19 P2:
*** Moves pink Plane from self (44) to self (51)
02:20 P1:
*** Moves green Libya from free-play to free-play
*** Moves pink Niger from free-play to free-play
02:22 P2: Senegal.
*** Moves yellow Mali from self (50) to free-play
*** Moves pink Senegal from free-play to self (50)

At this point, P2 sets a set of meeting places of Pink Senegal / Pink Plane / Pink Niger and Pink Niger / Car / Green Libya at the end of his sequence.

02:25 P1: You used that purple airplane for something?
02:26 P2: Yeah.
02:28 P1:
*** Move pink Plane from self (4) to free-play
02:40 P2: I don’t know what I wanna get rid of.
02:48 P1: Senegal right there.
02:48 P1: Angola.
*** Moves pink Senegal from self (2) to free-play
*** Moves yellow Angola from free-play to Known (28)
02:49 P1: You got that one?
02:52 P1: I need to put this in my actual thing.
*** Moves blue Plane from self (1) to self (0)
*** Moves yellow Central African Republic from self (3) to self (1)
02:52 P2:
*** Moves yellow Algeria from self (49) to self (44)
*** Moves yellow Mali from free-play to free-play
02:58 P1:
*** Moves green Botswana from self (5) to self (2)
*** Moves blue Mauritania from self (6) to self (3)
*** Moves yellow Mali from self (7) to self (4)
*** Moves orange Namibia from self (8) to self (5)
*** Moves pink Senegal from free-play to self (6)
*** Moves pink Plane from free-play to self (7)
*** Moves pink Niger from free-play to self (8)
At this point, P1 sets a set of meeting places of Pink Senegal / Pink Plane / Pink Niger and Pink Niger / Car / Green Libya at the end of his sequence.

*** Moves Car from free-play to self (9)
*** Moves green Libya from free-play to self (10)
03:11 P1: So you already picked up and put down already?

At this point both players have two sets of meeting places. The game continues.

10:00 P1: We got two things that’s the same.
10:01 P2: Right.
10:02 P1: We got two meet-up areas.
10:04 P2: It’s the same right there.
*** Makes 3 moves
*** Moves Car from self (53) to self (47)

At this point, the meeting places of Pink Niger / Car / Green Libya is broken up, put back together again, and then broken up again. From this point on, the pink meeting places stay intact for the rest of the game. No more conversation about meeting places occur and no more changes are made.

Summary
Players put together a set of car meeting places at the end of their journey. They don’t even notice that they also put together a set of pink places right next to the other ones. In the middle of the game, they notice that they have two sets of places. They keep the pink ones intact and break apart the car meeting places.
Meeting: Green Libya/ Car / Pink Niger in the beginning

00:12  Experimenter: Ok, go ahead.
00:13  P2: Do you wanna start going
00:14  P1: Can I go first, like Player 1? It doesn’t matter. I didn’t know.
00:22  P2: Do you wanna start going back or forward?
00:23  P1: Forward, I guess. I don’t know. If we can match them up forward, we could get that out of the way.
00:30  P2: Alright. Let’s see. We both have Libya.
00:32  P1: Yeah.
00:33  P1: Where is Libya at on here? <Referring to the map>
00:35  P2: Ah.
00:38  P1: It’s north. It’s green.
00:41  P2: Oh, ok, there.
00:44  P1: Is there anything we can drive around there?
00:47  P1: There is Niger in there, but...
00:52  P2: I have, I have Niger so if you take Niger, we can both drive to Libya
*** Moves pink Niger from self (44) to free-play
00:54  P1: Oh, you do?
00:55  P2: Yeah.
00:56  P1: Oh, ok.
00:57  P2: So, start with Libya and drive to Niger
*** Moves green Libya from self (53) to self (44)
*** Moves DR Congo from self (45) to free-play
*** Moves Car from self (51) to self (45)
*** Moves yellow Plane from self (46) to free-play
*** Moves pink Niger from free-play to self (46)

At this point in time, P2 has established a set of meeting places in the beginning of his journey of green Libya / Car / pink Niger.

01:02  P1:
*** Moves green Libya from self (2) to free-play
*** Moves Car from self (0) to free-play
*** Moves green Libya from free-play to self (0)
*** Moves blue Plane from self (1) to free-play
*** Moves Car from free-play to self (1)
01:07  P1: Ok. Is it? So, I’ll go first then, right?
01:08  P2: Yeah, it would be your turn.
01:10  P1: Alright, that’s fine.
*** Draws pink Niger from Known (30) to free-play
*** Moves pink Niger from free-play to self (2)
At this point in time, P1 has established a set of meeting places in the beginning of his journey of green Libya / Car / pink Niger.

01:13 P1: So, what should I discard then?
01:15 P2: I’d say get rid of a country probably.
01:19 P1: I guess it doesn’t matter right now. Ok. And then, what color is Niger then? Niger is…
*** Discards blue Mauritania from self (8) to Known (30)
01:28 P2: Pink.
01:30 P1: We might check if you have to switch Libya and Niger. It’s gonna be the same. <muffled> I mean, you might have to.
01:36 P2: Oh, yeah yeah yeah. I see what you’re saying.
01:40 P1: So, we have that either way.
01:43 P2: But I have a pink plane, so I can fly to a pink country.
01:52 P1: Well, I have a pink plane too.

The game continues. No more conversation about the meeting places occur.

Summary
Players start out deciding to go from left to right and establishing meeting places. They determine that they both have Libya and a car. They determine that they can drive to Niger. P2 already has Niger and P1 can draw it from the known pile. Thus, they both establish the meeting places quickly and with no changes. They do understand that they can change the order of their triad.
No Color-Text
Female # 57
Meeting: Pink Senegal / Pink Plane / Pink Niger in the beginning

00:12 Experimenter: Ok, go ahead.
00:15 P2: Ummm, let’s see. We both have a pink plane.
00:17 P1: Yeah, the pink plane and. Let’s see. We both have. We both have Libya.
00:28 P2: Ok, what color is Libya?
00:32 P1: Libya is green.
00:35 P2: Ok, so.
00:36 P1: Do we wanna stick with.
00:38 P2: Should we stick with and try to do green or do we wanna try to find maybe, since we both have a pink and…
00:39 P1:
*** Moves pink Plane from self (5) to free-play
*** Moves Central African Republic from self (4) to self (5)
*** Moves pink Senegal from self (3) to self (4)
00:44 P1: Well, let’s see if we have another green country
00:46 P2: Ok.
01:03 P1: I don’t think I have another green country.
01:04 P2: I’m not. I don’t think. Wait, I have Dominic Republic of Congo, of Congo. That’s green.
01:09 P1: Well, for now we’ll go with green until something else comes up.
<opportunist planning?>
01:14 P2: Ok.
01:17 P2: So, we’ll both start and put Libya at the beginning.
01:19 P1: Yeah, that works.
01:19 P1:
*** Moves green Libya from self (0) to self (3)
*** Moves green Libya from self (3) to self (0)
01:20 P2:
*** Moves green Libya from self (53) to free-play
*** Moves pink Niger from self (44) to free-play
*** Moves green Libya from free-play to self (44)
*** Moves green DR Congo from self (45) to free-play
01:26 P1:
*** Moves blue Plane from self (1) to self (2)
01:27 P2: Ah, let’s see.
01:28 P2:
*** Moves pink Plane from self (54) to self (53)
01:28 P2: Ethiopia is orange. Algeria is orange.
01:46 P1:
*** Moves Central African Republic from self (5) to free-play
*** Moves pink Plane from free-play to self (5)
01:55 P2: <whispering>…blue…Egypt…Mali is yellow along with…
02:11 P1: Are you using your Niger?
02:15 P2: I don’t think I’m gonna use Niger.
02:19 P2: Do you have? Is there a country or a card that you want, like from mine? Let’s do Mali and…I’ve got, let’s see…maybe the…I’m trying to see if I need…which country…let’s see. We start in Libya; we need a green a green. I have Dominican Republic. Finding the colors is sort of <laughing>.

*** Moves yellow Central African Republic from free-play to free-play
*** **Moves Botswana from self (6) to free-play**
*** Moves orange Namibia from self (10) to self (6)
*** Moves yellow Mali from self (9) to self (10)
*** Moves Car from self (3) to self (9)

02:58 P2: Yeah.
03:04 P2: Ok, Algeria is orange and Mali is yellow but I can drive between…
03:08 P2: Algeria is blue. Wait, which one?
03:12 P2: Algeria.
03:13 P1: Algeria. Ok.
03:15 P2: So, maybe I can drive to these two. And then from Mali, I can drive maybe to…Angolia is…oh, Angolia is yellow along with. So, I could even fly between the

*** Moves yellow Mali from self (50) to self (51)
*** Moves Car from free-play to self (49)
*** Moves Car from self (49) to free-play
*** Moves yellow Plane from self (46) to self (50)

03:21 P1:
*** Moves orange Ethiopia from self (7) to self (3)
*** Moves orange Ethiopia from self (3) to free-play

03:32 P1: Mmmm, Nambia…
03:32 P2:
*** Moves yellow Mali from self (51) to free-play
*** Moves yellow Plane from self (50) to self (51)
*** Moves yellow Mali from free-play to self (50)

*** Moves orange Algeria from self (49) to free-play
*** Moves Car from free-play to self (49)
*** Moves orange Ethiopia from self (48) to free-play
*** **Moves pink Niger from free-play to self (48)**
*** Moves orange Ethiopia from free-play to free-play

03:41 P1:
*** Moves blue Plane from self (1) to self (7)
*** Moves orange Namibia from self (6) to self (3)
03:46 P2: And then a pink plane from Niger.
*** Moves blue Burkina Faso from self (47) to free-play
*** **Moves pink Plane from self (53) to self (47)**
03:47 P2: This is green we are both trying to start with. So, I might have to…Let’s see, where can I from Angolia. So, I can drive
*** Moves yellow Angola from free-play to self (53)
*** Moves yellow Plane from self (51) to self (52)
04:05  P1: Green. Libya is green so I can just need a green car or plane.
***  Moves green Botswana from free-play to self (2)
04:10  P2: Yeah, I think just a green plane and then…
***  Moves green DR Congo from free-play to self (46)
***  Moves pink Plane from self (47) to free-play
04:20  P1: Ethiopia is…
04:25  P2: I’ll have to drive from there to Angolia
***  Moves Car from self (49) to self (47)
***  Moves yellow Angola from self (52) to self (49)
04:28  P1: Orange.
04:28  P2:
***  Moves pink Niger from self (48) to self (51)
04:30  P2: Drive from the Dominican Republic to
04:33  P1:
***  Discards yellow Central African Republic from free-play to Known (28)
***  Picks up pink Niger from Known (30) to self (6)
04:36  P1: Ok, I used a turn.
04:37  P2: Ok. I need to drive from Angolia to Mali.
***  Moves yellow Angola from self (49) to self (48)
***  Moves yellow Plane from self (52) to self (48)
04:48  P1:
***  Moves blue Namibia from self (3) to free-play
04:50  P2: …I’ll need another car. Ethiopia is orange. And you still have your Ethiopia.
05:01  P1: Yes, do you need it?
05:02  P2: Well, I’m just trying to find maybe a meeting spot for us.
05:04  P1: Ok, well, I also have Botswana which is also green, also.
05:13  P2: Ok.
05:15  P1: Cause we are looking for a green one, right?
05:16  P2:  Mhm.
05:17  P1: Ok, so if can find
05:19  P2: Maybe a Botswana.
05:20  P2: Maybe we can find one of the others.
05:22  P1: Yeah.
05:23  P2: Alright, I’m gonna draw a card…Senegal.
***  Draws pink Senegal from Unknown (26) to free-play
05:26  P1: I need to find an…
05:27  P1: I have Senegal too, and then we both have a pink one.
05:35  P2: And then do we have another pink one?
05:38  P1: I don’t know, I can’t. Oh, I have Niger.
05:42  P2: And I have Niger as well. So, there we can do Senegal and Niger.
05:47  P1: Ok, yeah. We can do that at the beginning.
05:48  P2:
***  Move pink Niger from self (52) to self (54)
05:50  P2: Ok
05:51  P1: So, we’ll go from Senegal to Niger. Let’s see what I wanna get rid of really quick before my turn is over. And then from Niger, drive to…
*** Moves green Libya from self (0) to free-play
*** Moves green Botswana from self (2) to free-play
*** Moves pink Senegal from self (4) to self (0)
*** Moves pink Plane from self (5) to self (1)
*** Moves pink Niger from self (6) to self (2)

At this point, P1 has three meeting places of Pink Senegal / Pink Plane / Pink Niger established at the beginning of her sequence.

05:52 P2:
*** Moves green Libya from self (44) to free-play
*** Moves pink Plane from free-play to self (45)
*** Moves pink Senegal from free-play to self (44)
*** Moves green DR Congo from self (46) to free-play
*** Moves pink Niger from self (54) to self (46)

At this point, P2 has three meeting places of Pink Senegal / Pink Plane / Pink Niger established at the beginning of her sequence. The game continues and no more conversation about meeting places occurs and no changes are made.

Summary
The players started with trying to set up green meeting places. At some point, P1 draws a Niger from the Known pile and then they draw Senegal from the Unknown. At that point, they notice the pink opportunities and set up the pink meeting places.
No Color-Text
Female # 49
Meeting: Green Libya / Car / Pink Niger at the end

00:09  Experimenter: Ok, go ahead and begin.
00:11  P2: Ok
00:12  P1: Ok, which ones of these do we have the same?
00:17  P1: I see Libya. We both have the same.
***  Moves Green Libya from self (2) to free-play
00:22  P2: Yeah, ok.
***  Moves green Libya from self (53) to free-play
00:24  P1: Ok, Mali. Is it Mali?
***  Moves yellow Mali from self (9) to free-play
00:26  P2: Yeah, Mali. I don’t know, whatever.
***  Moves yellow Mali from self (50) to free-play
00:30  P1: We have those two the same.
00:37  P1: Mali is yellow.
00:40  P2: Libya is green.

Focus on color first even though the Text is there.

00:41  P2: Libya is green. So we can’t really use both of those together, right? <Isn’t thinking about the car option>
00:44  P1:
***  Move Namibia from self (10) to free-play
00:50  P1: Hold on a minute. We have Ethiopia, the same.
***  Moves orange Ethiopia from self (7) to free-play
01:03  P2: And it’s orange.
01:09  P1: Ah
01:11  P2: I guess that’s all.
01:18  P2: Oh, well, the Niger is in the draw pile and I have a Niger. So, you could take that.
01:22  P1: Ok.
01:23  P2: And that goes…you can use that with Libya.
01:25  P1:
***  Draw pink Niger from Known (30) to self (9)
01:28  P2: You can use that with Libya and a car. They share a border.
01:32  P1: Ok, so
***  Moves pink Niger from self (9) to self (10)
01:35  P2: So, do you wanna put it at the end?
01:36  P1: Yeah, at the end.
01:36  P2:
***  Moves pink Plane from self (54) to free-play
01:38  P1: Car
***  Moves Car from self (0) to self (9)
***  Moves blue Mauritania from self (8) to self (7)
01:40  P2:
***  Moves pink Niger from self (44) to self (54)
***  Moves Car from self (51) to self (53)
***  Moves yellow Angola from self (52) to self (51)
***  Moves green Libya from free-play to self (52)

At this point, P2 established a set of meeting places at Green Libya / Car / Pink Niger at the end of her sequence.

01:47  P1: Is it Libya?
***  Moves yellow Mali from free-play to free-play
***  Moves green Libya from free-play to self (8)
01:51  P1: Ok, right.
01:53  P2: Ok.

At this point, P1 established a set of meeting places at Green Libya / Car / Pink Niger at the end of her sequence. The game continues. No more conversation about the meeting places occurs.

Summary
Trying to find which three they both have in common. They find Libya and Niger, but P2 is only thinking about color and therefore, flying. They realize that they can drive and both have a car. They decide to have the meeting places at the end (P2 asks and P1 responds). No changes to the meeting places are made.
No Color-No Text
Male # 23
Meeting: Pink Senegal / Pink Plane / Pink Plane / Pink Niger in the beginning

00:15  Experimenter: Ok, please begin.
00:18  P1: Let’s look for the same countries.
00:21  P2: Yeah.
00:22  P1: Libya. What color is Libya?
00:23  P2:
*** Moves Libya from self (53) to free-play
00:38  P2: Libya is green.
00:40  P1: Ok.
00:45  P2: We both have Mali.
00:46  P2:
*** Moves yellow Mali from self (50) to free-play
00:50  P2: That’s yellow. We have it both. Yeah, there is a yellow plane face-up and I have a yellow plane.
00:52  P1:
*** Moves green Libya from self (2) to free-play
*** Moves yellow Mali from self (9) to free-play
01:00  P2:
*** Moves yellow Plane from self (46) to free-play
01:01  P1:
*** Picks up yellow Plane from Known (29) to free-play
01:05  P1: You wanna put Mali at the end maybe?
*** Moves orange Namibia from self (10) to free-play
*** Moves yellow Mali from free-play to self (10)
*** Moves yellow Plane from free-play to self (9)
01:10  P2: Yeah. What’s? We both have Ethiopia. What’s that?
01:15  P1: Ethiopia is orange.
01:18  P2: Orange.
01:22  P1:
*** Moves orange Ethiopia from self (7) to free-play
01:26  P1: And then there is Niger. That’s…that’s. But, somebody has to go on that one.
01:26  P2:
*** Moves orange Ethiopia from self (58) to free-play
01:39  P2:
*** Moves pink Niger from self (44) to free-play
01:45  P1:
*** Moves blue Mauritania from self (8) to free-play
*** Moves Car from self (0) to free-play
*** Moves blue Plane from self (1) to free-play
*** Moves pink Senegal from self (3) to self (0)
*** Moves pink Plane from self (5) to self (1)
02:09  P2:
*** Moves pink Plane from self (54) to free-play
*** Moves yellow Mali from free-play to self (54)
*** Moves yellow Plane from free-play to self (53)
*** Moves yellow Angola from self (52) to free-play
*** Moves Car from self (51) to free-play
02:15 P1: So, you’re going first?
02:17 P2: Yeah.
02:18 P1: Ok. So, I’ll go next. Oh, you need to discard something.
02:23 P2: I do?
02:24 P1: Yeah.
02:27 P2: Yeah. Ah…
*** Discards DR Congo from self (45) to Known (29)

<P1 is actually the one that drew a card before>
02:35 P1: You wanna discard Niger?
02:26 P2: Yeah

<P1 told P2 to discard a card that he will later needs; P2 Textened and did it>
*** Picks up green DR Congo from Known (29) to self (46)
*** Discards pink Niger from free-play to Known (29)
02:45 P1: I’m gonna…
*** Discards blue Botswana from self (6) to Known (30) <on top of Niger>
*** Picks up ANOTHER pink Niger from Known (29) to free-play
*** Moves pink Niger from free-play to self (2)

At this point P1 has the meeting places of Pink Senegal / Pink Plane / Pink Niger at the beginning of his sequence. However, P1 does not yet consider this as meeting places.

02:50 P1: Let’s find a country that’s the same color as yellow.
02:52 P2: Ok.
02:53 P1: It’s your turn now.

<P1 has 12 cards and doesn’t know it; P2 has only 10 cards>
03:15 P2: I have Angola.
03:28 P1:
*** Moves Car from free-play to self (3)
*** Moves yellow Central African Republic from self (4) to free-play
03:36: P1: You wanna discard Algeria maybe?
03:40 P2: Let’s see. Yeah.
*** Discards Algeria from self (49) to Known (29)
03:45 P1: Have you taken a country?
03:46 P2: No. Let’s see. Let’s see what color is that.
*** Picks up pink Senegal from Unknown (26) to free-play.
04:15 P2:
*** Moves pink Senegal from free-play to self (44)
*** Moves DR Congo from self (46) to free-play
*** Moves Burkina Faso from self (47) to free-play
*** Moves pink Plane from free-play to self (45)
04:28 P1: Have you taken a country?
04:29 P2: Yeah.
04:31 P1:
*** Picks up Algeria from Known (29) to self (4)
04:37 P2: What is the Central Africa? What color is that? Ok, never mind.
*** Moves yellow Central African Republic from free-play to self (8)
04:50 P1: I need to discard something. Let’s see.
*** Discards blue Mauritania from free-play to Known (29)
*** Moves orange Ethiopia from free-play to self (6)
*** Moves blue Plane from free-play to free-play

Some moves and conversation goes by without contributing to meeting places.

*** P2 makes 9 moves
*** P1 makes 4 moves

07:57 P1: We both have Ethiopia right?
08:00 P2: Yeah.
08:03 P1: What color is that? That’s orange. Ah, we could put that there, take this out, and put a car.
*** Moves yellow Central African Republic from self (8) to free-play
*** Moves orange Ethiopia from free-play to self (8)
*** Moves yellow Plane from self (9) to free-play
*** Moves Car from free-play to self (9)
08:14 P2:
*** Moves orange Ethiopia from free-play to self (52)
*** Moves yellow Plane from self (53) to free-play
08:16 P1: And that would settle that.
08:17 P2:
*** Moves Car from free-play to self (53)
08:24 P1: Does that work?
08:25 P2: I don’t know. They are not next to each other.
08:26 P1: Oh, they aren’t?
08:27 P2: No. Mali’s over here but not…
08:33 P1: Oh, yeah. So…
08:35 P2:
*** Moves Car from self (53) to free-play
08:37 P1: Ok, that doesn’t work.
*** Moves Car from self (9) to free-play
*** Moves orange Ethiopia from self (8) to free-play
*** Moves yellow Mali from self (10) to free-play
*** Moves orange Ethiopia from free-play to self (10)
08:45 P1: Let’s see what’d happen if I did that.
*** Moves Car from free-play to self (9)
08:52 P1: Do you have any countries next to Ethiopia?
09:02 P2: I don’t think I do. No, I don’t.
09:16 P1: Have you went, recently?
09:18 P2: No. …that’s yellow. You want the democratic thing?
Discards DR Congo from free-play to Known (28)

10:00 P1:

Discards green Libya from free-play to Known (30)

10:40 P2: I kind of want Libya. Well, it's on the deck.

12:02 P2:

At this point P2 has the meeting places of Pink Senegal / Pink Plane / Pink Niger at the beginning of his sequence. The game continues and no more conversation about the meeting places occurs and no changes are made.
The players first try to establish meeting places at the end of Yellow Plane / Yellow Mali. However, a third matching one is not coming up. At some point, P1 suggests driving between Ethiopia and Mali, but that doesn’t work. They notice the pink in the beginning and P2 is only missing Niger. As soon as Niger comes up, they complete the meeting places. P1 seems to be very dominant in the game by telling P2 what to do and asking him for cards that he is clearly using. P2 is compliant every time and pretty much allows P1 to be ahead. Ironically, P2 wins.
No Color-No Text
Male # 25
Meeting: pink Senegal / Car / Yellow Mali in the beginning

00:16 Experimenter: Ok, go ahead.
00:19 P2: Ok, we both have a purple airplane, or pink.
00:23 P1: Do we have anything else?
00:24 P2: Um
00:25 P1: We have a Libya.
00:26 P2: We both have Ethiopia.
00:27 P1: And Libya
00:28 P2: And Libya.
00:35 P1: Libya…
00:38 P2: Ok.
00:44 P2: Libya is blue? Or, no, Libya is green.
00:46 P2: And what is…Ethiopia is orange.
00:55 P1: Alright.
01:00 P2: Just let me see what we have in common.
01:02 P1: What color was Libya?
01:03 P2: We also have Mali. Mali, which is yellow. We …
01:09 P2: You could get that yellow airplane on the next turn.
01:11 P1: Yeah, so do you just wanna...<can’t hear because P2 is breathing into the mic> Libya <breathing>
*** Moves Car from self (0) into free-play
01:19 P2: No, no. What we should do is we should start in Mali
*** Moves Mali from self (50) to first spot in free-play
01:24 P2: You should take out that yellow airplane on your turn, cause this is your turn.
*** Moves yellow Plane from self (46) to free-play next to yellow Mali

At this point, the players seem to be focusing on color

01:26 P1: Ok
01:27 P2: And then, what can we hook Mali to? Um, that doesn’t, um, cause you don’t have anything else. Um, maybe not <referring to the below move>
*** Moves yellow Plane from free-play back to self (46) <seems to be rejecting that idea because can’t find a link>
01:42 P2: Wait, this plane, Mali doesn’t. Does Mali touch anything else? We have Libya and Ethiopia. No. Hmmm.
01:53 P1: We have a car also.
01:45 P2: Yeah. None of our countries touch this, so maybe we should just go through a turn and see what we can get.
*** Moved yellow Mali from free-play back to self (50)
*** Moved yellow Mali from self (50) to free-play
*** Moved Car from self (51) to free-play <next to Mali>
*** Moved yellow Angola, green Libya, & pink Plane from self (52, 53, 54) to free-play
*** Moves everything he has into free-play

02:10 P1

*** Draws yellow Plane from Known

02:20 P1: Hmmm.

*** Discards pink Senegal from self (3) to Known (29)

02:25 P1: Ok

*** Moves 3 cards into free-play area

02:28 P2: I got Senegal. What’s Senegal? What color is that?

02:33 P1: It’s pink. It’s on the left.

02:34 P2: Pink. We both have a pink airplane so if you took that Senegal back. I don’t know.

02:40 P1: I didn’t even notice that.

02:42 P2: Do we have another pink color? No, we don’t. So, that doesn’t really help us. But Senegal does touch Mali. So, if you take Senegal back on this turn.

*** Moves pink Senegal from self (47) to self (44)

*** Moves yellow Mali from free-play to self (46)

02:50 P1: Ok

02:53 P2: Then if we attach them with the car, then that’s the three that we need

*** Moves Car from free-play to self (45)

P2 establishes a set of three meeting places at this point of pink Senegal / Car / yellow Mali. There is no discussion of end vs. beginning. P1 just places his there.

03:00 P2: So, do you wanna start the trip like that or what?

03:02 P1: Might as well

03:03 P2: Ok.

03:07 P1:

*** Moves Car from free-play to self (1)

*** Moves yellow Mali from self (9) to self (2)

*** Moves 6 cards to free-play

03:13 P2: Mali, yellow airplane to Angola. Ok.

03:20 P1: Did you take your turn?

03:21 P2: Oh, not yet.

*** Draws green Plane from Unknown (26)

03:28 P2: Ok, I need to discard first.

*** Discards and also moves 12 cards in mostly free-play

03:35 P2: It’s your turn.

03:39 P1:

*** Draws pink Senegal from Known (29) to self (0)

At this point, P2 also established the same set of meeting places as P1 of pink Senegal / Car / yellow Mali. The game continues.

Summary

The subjects are first focused on plane travel and discuss color. But they don’t have a readily available card that links to yellow Mali and yellow Plane. P2
notices that Senegal (which one of them has and the other one draws upon first turn) borders Mali and they both have a car. Thus, they establish that triad as a set of meeting places occurring at the beginning of the journey. P2 seems to be dominant in conversation and suggestions of what do to (P2 wins).
Experimenter: Ok, please begin.

P2: Well, do you wanna start off by getting the three that we need the same? We both have a pink airplane so do you wanna see if we have countries that go with the pink airplane?

P1: Yes.

P2: Ok.

P1:

*** Moves yellow Mali from self (9) to free-play

*** Moves pink Plane from self (5) to self (9)

P2: Well, do we have any of the same countries?

P1: Egypt, <unclear>

P2: We both have a Liberia. Is that pink?

P1: We do?

P2: Yeah.

P1: Oh, yeah.

P1: What do we got? Senegal or something?

P2: Do what?

P1: Oh, you do have it.

P1:

*** Moves orange Namibia from self (10) to free-play

*** Moves pink Senegal from self (3) to self (10)

P1: Do you have that one? <referring to Senegal> The one I just moved?

P2: ...those two?

P1: Aha.

P2: I’ve got this one. <referring to Mali>

*** Moves yellow Mali from self (50) to free-play

P1: You got Mali

*** Moves yellow Mali from free-play to free-play

P1: What color is that?

P2: What?

P1: Is that pink? There are 1, 2, 3, 4, 5, 6, 7, 8…8 pinks. It’s yellow.

P2: What’s yellow?

P1: Mali. The same one we got alike.

P2: Well, there is a card in the discard pile that’s yellow and you can use that one. We’ll put them at the end.
*** Moves yellow Plane from free-play to self (9)
02:02 P2:
*** Moves yellow Plane from self (50) to self (52)
*** Moves green Libya from self (53) to self (49)
02:03 P1: Does that make sense?
02:04 P2: …this one.
*** Moves yellow Plane from self (52) to self (53)
*** Moves yellow Mali from free-play to self (52)
02:06 P1: Did you get? Ok. Ok.
02:10 P2: I’m moving a pink plane.
*** Moves pink Plane from self (54) to free-play
*** Moves yellow Mali from self (52) to self (54)
02:12 P1: Ok, so now, you have…
02:17 P2: What about Kenya. Do you have Kenya?
02:19 P1: Mmmm.
02:23 P2: Me neither.
02:25 P1: We both need another yellow country.
02:31 P2: Do you have a yellow country?
02:32 P1: I have Central…ah, yep. Yes, I do.
02:35 P2: What is it?
02:37 P1: It is Central African Republican. You got that one?
*** Moves pink Senegal from self (8) to free-play
*** Moves yellow Central African Republic from self (4) to self (8)
02:43 P1: I just moved it.
02:45 P2: No. But I can get it.
02:52 P1:
*** Moves green Botswana from self (6) to self (5)
*** Moves orange Ethiopia from self (7) to self (6)
02:55 P1: Is it your turn?
02:58 P2: You took one out. You gotta discard.
03:00 P1:
*** Discards blue Mauritania from free-play to Known (29)
03:03 P2: Ok, let’s see.
*** Moves pink Plane from free-play to self (52)
03:13 P2: Ok, I have this. Do you have? No.
*** Moves pink Plane from self (52) to free-play
*** Moves yellow Angola from self (46) to self (52)
03:20 P1:
*** Moves Car from self (0) to free-play
*** Moves blue Plane from self (1) to free-play
*** Moves green Libya from self (2) to free-play
*** Moves pink Senegal from free-play to self (0)
*** Moves pink Plane from free-play to self (1)
03:30 P1: <sighing> Ok.
03:35 P2: <laughing> Let’s see. Madagascar is purple.
03:44 P1: Niger
*** Picks up pink Niger from Known (29) to self (2)

At this point, P1 has three meeting places of Pink Senegal / Pink Plane / Pink Niger established at the beginning of her sequence.

*** Discards orange Ethiopia from self (6) to Known (29)
03:52 P2: We both have Nigeria now <referring to Niger> What color is that?
03:54 P1: You know Nigeria goes with, it’s pink.
03:57 P2: Aha.
03:58 P1: It goes with Senegal. Do you got it? The one I just moved?
04:05 P2: Where is it?
04:09 P1: It’s up there.
04:10 P2: The S-one, oh?
04:11 P1: Yeah.
*** Draws pink Senegal from Unknown (26) to free-play
04:18 P1: Woohoo!
04:21 P2: Ok, let’s move that. Alright. Now I gotta move the pink airplane.
*** Moves pink Niger from self (44) to free-play
*** Moves green DR Congo from self (45) to free-play
*** Moves pink Senegal from free-play to self (44)
*** Moves blue Burkina Faso from self (46) to free-play
*** Moves pink Plane from self (47) to self (45)
*** Moves pink Niger from free-play to self (46)
04:30 P2: Alright, now we got our … <referring to meeting places>

At this point, P2 has three meeting places of Pink Senegal / Pink Plane / Pink Niger established at the beginning of her sequence. The game continues and no more conversation about the meeting places occurs.

Summary
The players first decide on yellow meeting places at the end of their sequences that they start putting together. As the game goes on, they notice the pink opportunities. P1 puts them together at the beginning of her sequence without saying anything. Then P2 draws pink Senegal and has the same three cards that she puts at the beginning of her sequence.
No Color-No Text
Female # 55
Meeting: Green Libya / Car / Pink Niger in the beginning

00:09  Experimenter: Ok, go ahead, please.
00:10  P2: Alright.
00:18  P2: We both have Libya.
00:19  P1: Do we?
00:20  P2: Yes.
00:21  P1: Ok.
00:23  P1: Yeah, we do. What color is Libya?
00:24  P2: Um
00:28  P1: It’s green.
00:29  P2: Green.
00:30  P1: But neither one of us have a green plane.
00:33  P2: Do we have a country that’s green that we could wait for a green plane for?
00:40  P2: What’s Ethiopia? Cause we both have that too.
00:44  P1: Ethiopia is orange.
00:45  P2: Dang.
00:50  <Laughing>
00:53  P1: Can we drive to anything?
00:56  P1: I don’t have anything I can drive to.
01:02  P2: Lybia
01:07  P1: Niger...No. ...<unclear> Nope. Chad… You can drive to Niger. And I don’t have it.
01:20  P2: Hmmm. Ah...
01:23  P1: Unless, I pick it up from here <referring to Known (30)>
01:28  P2: Yeah, you could. I don’t know what that sound was. Ok, let’s do that.
01:33  P2: Alright, do you wanna go first or me? Well, actually, I’ll just rearrange and you can go first.
***  Moves Yellow Angola from self (52) to free-play
01:40  P1: You wanna make it at the beginning or the end? Meet up at …
01:43  P2: Let’s make it at the beginning so we can just go from, forward, not backward.
***  Moves Green Libya from self (53) to self (52)
***  Moves Pink Niger from self (44) to free-play
***  Moves DR Congo from self (45) to free-play
01:46  P1: At the beginning, ok.
***  Moves Car from self (0) to free play
01:47  P2:
***  Moves Green Libya from self (52) to self (44)
***  Moves Car from self (51) to self (45)
01:42  P1: So, it was Libya.
01:52  P2:
***  Moves Yellow Plane from self (46) to self (51)
***  Moves Pink Niger from free-play to self (46)
At this point, P2 established as set of meeting places of Green Libya / Car / Pink Niger at the end of his sequence.

01:53  P1:
*** Moves Green Libya from self (2) to self (0)

01:53  P2:
*** Moves Yellow Angola from free-play to self (53)
*** Moves DR Congo from free-play to self (52)

01:56  P1: We can drive to Niger
*** Moves Blue Plane from self (1) to free-play
*** Moves Car from free-play to self (1)

02:00  P1: What am I discarding?

02:10  P1: I’ll discard Botswana or whatever that is.
*** Discards Blue Botswana from self (6) to Known (28)
*** Picks up Pink Niger from Known (30) to free-play.
*** Moves Pink Niger from free-play to self (2)

02:20  P1: Now it’s your turn.

02:22  P2: Ok.

Some moves take place.

02:52  P2: Or it may be. Cause I have…well, never mind. I don’t have a green plane. I was gonna say we could switch Niger and Libya, but that wouldn’t work anyway.

03:08  P1: I don’t have a green plane either. I was trying to find a way for you to get to another pink country like Nigeria.

03:14  P2: I know. I don’t think I have any other pink countries.

03:22  P1: We might just have to switch. Cause this Macarene <probably referring to Burkina Faso> is like, blue.

At this point, P1 established as set of meeting places of Green Libya / Car / Pink Niger at the end of his sequence. The game continues and there is no more conversation about the meeting places.
### Appendix G: State-space Representations Organized by Condition.

#### Color-List

- Male # 40

**Meeting: Pink Niger / Pink Plane / Pink Senegal at the beginning**

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Object</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>None</td>
<td>Pink Plane</td>
<td>Self (5)</td>
<td>free-play</td>
<td>None</td>
<td>Pink Niger / None</td>
<td>None</td>
</tr>
<tr>
<td>P2</td>
<td>None</td>
<td>Pink Plane</td>
<td>Self (5)</td>
<td>free-play</td>
<td>None</td>
<td>Pink Niger / None</td>
<td>None</td>
</tr>
</tbody>
</table>

1. P1 makes 5 moves with a Car in free-play and 1 other move to free-play

2. P2 makes 1 move from free-play to free-play

3. P2 makes 1 move to free-play

4. P2 makes 1 discard and 1 move from free-play

5. P2 makes 1 move to free-play

6. P2 makes 1 move to free-play

7. P2 makes 1 move to free-play

8. P2 makes 1 move to free-play

9. P2 makes 1 move to free-play

10. P2 makes 1 move to free-play

11. P2 makes 1 move to free-play

12. P2 makes 1 move to free-play

13. P2 makes 1 move to free-play

14. P2 makes 1 move to free-play

15. P2 makes 1 move to free-play

16. P2 makes 1 move to free-play

At this point, P2 has established a set of three meeting place of Pink Niger / Pink Plane / Pink Senegal at the beginning of his journey.

17. P2 makes 2 moves to free-play

18. P2 makes 2 moves to free-play

At this point, P1 has established a set of three meeting place of Pink Niger / Pink Plane / Pink Senegal at the beginning of his journey. The game continues. No more conversation about the meeting places occur and no changes are made.
Meeting: Yellow Mali / Car / Pink Niger at the end

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1</td>
<td>None</td>
<td>Niger</td>
<td>Pink</td>
<td>Pink (30)</td>
<td>Self (6)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>P1</td>
<td>None</td>
<td>Niger</td>
<td>Pink</td>
<td>Self (47)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>P1</td>
<td>None</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (54)</td>
<td>Self (47)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>P1</td>
<td>None</td>
<td>Niger</td>
<td>Pink</td>
<td>Self (54)</td>
<td>Exit</td>
<td>None / None / Pink Niger</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>P1</td>
<td>None</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (50)</td>
<td>Self (53)</td>
<td>None / None / Pink Niger</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>P1</td>
<td>None</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (53)</td>
<td>Self (50)</td>
<td>None / None / Pink Niger</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>P1</td>
<td>None</td>
<td>Car</td>
<td>Self (51)</td>
<td>Self (53)</td>
<td>Connector</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>P1</td>
<td>None</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (50)</td>
<td>Self (52)</td>
<td>Yellow Mali / Car / Pink Niger</td>
<td>Complete</td>
</tr>
<tr>
<td>9</td>
<td>P1</td>
<td>None</td>
<td>Niger</td>
<td>Pink</td>
<td>Self (6)</td>
<td>Self (10)</td>
<td>None / None / Pink Niger</td>
<td>Complete</td>
</tr>
<tr>
<td>10</td>
<td>P1</td>
<td>Yellow Mali</td>
<td>Car</td>
<td>Self (6)</td>
<td>None</td>
<td>None / None / Pink Niger</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>P1</td>
<td>None</td>
<td>Car</td>
<td>Self (6)</td>
<td>free-play</td>
<td>None / None / Pink Niger</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>P1</td>
<td>None</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (9)</td>
<td>Entrance</td>
<td>Yellow Mali / None / Pink Niger</td>
<td>Complete</td>
</tr>
<tr>
<td>13</td>
<td>P1</td>
<td>Yellow Mali</td>
<td>Car / Pink Niger</td>
<td>Car</td>
<td>free-play</td>
<td>Self (9)</td>
<td>Connector</td>
<td>Yellow Mali / Car / Pink Niger</td>
</tr>
</tbody>
</table>

At this point, P1 established as set of meeting places of Yellow Mali / Car / Pink Niger at the end of his sequence. The game continues and there is no more conversation about the meeting places.
### Color-List

**Meeting: Pink Senegal / Pink Plane / Pink Niger in the middle**

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Name</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>P2 None</td>
<td>P2 Niger</td>
<td>Pink</td>
<td>Self (44)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>P1 makes 3 moves; P2 makes 8 moves</td>
<td></td>
<td></td>
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At this point, P1 have a set of meeting places of Pink Senegal / Pink Plane / Pink Niger established in the middle of her sequence.
## Color-List

**Female # 51**

### Meeting: Pink Senegal / Car / Yellow Mali at the end

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<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
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<th>Resulting State</th>
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</table>

Senegal will become relevant later. P2 makes 1 move that is not productive towards meeting place establishment.

### Several moves made not productive towards meeting place - approximately 1 draw & 1 discard by P2.

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<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
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<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Senegal</td>
<td>Orange Ethiopia</td>
<td>Pink (20)</td>
<td>Yellow Mali</td>
<td>Known (28)</td>
<td>None</td>
<td>Orange Ethiopia / Car / Yellow Mali</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Pink Senegal</td>
<td>Orange Ethiopia</td>
<td>Pink (20)</td>
<td>Yellow Mali</td>
<td>Known (28)</td>
<td>None</td>
<td>Orange Ethiopia / Car / Yellow Mali</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Several moves made not productive towards meeting place - approximately 1 draw & 1 discard by P2.

### Have three identical cards established at the end of orange Ethiopia / Car / yellow Mali. However, one cannot drive between Ethiopia and Mali. This is not explicitly stated by the subjects. Approximately 5 draws (P1: 3 / P2: 2) occur.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Senegal</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
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<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P1: Pink Senegal / Car / Yellow Mali</td>
<td>P1: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

### P1 Places two orange cards in a row in free-play

<table>
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<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Senegal</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

### P1 makes 1 move; P 2 makes 3 moves of green cards in the sequence area & 2 more of others

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Senegal</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
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</tbody>
</table>

### P2 makes 2 moves

<table>
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<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Senegal</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

### P1 makes 1 move; P 2 makes 3 moves of green cards in the sequence area & 2 more of others

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Senegal</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
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</table>

### P1 makes 1 move; P 2 makes 3 moves of green cards in the sequence area & 2 more of others

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Orange Ethiopia / Car / Yellow Mali</td>
<td>P1: Senegal</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2: None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

### Meeting places are established as pink Senegal / Car / yellow Mali at the end. No explicit conversation about this achievement occurs. About 29 draws (P1: 15 / P2: 14) occur.
No Color-List
Make # 42
Meeting: Pink Senegal / Pink Plane / Pink Niger in the middle

## Initial State

<table>
<thead>
<tr>
<th>Player</th>
<th>Player Name</th>
<th>Color</th>
<th>Origin</th>
<th>Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>None</td>
<td>Libya</td>
<td>Green</td>
<td>Self (54)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2</td>
<td>None</td>
<td>Libya</td>
<td>Green</td>
<td>Self (54)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

1. P2 makes 1 move in self
2. P1 makes 1 discard
3. P1 makes 1 move in self
4. P1 makes 3 moves in self
5. P1 makes 1 move in self
6. P1 makes 1 move to free-play
7. P2 makes 1 move to free-play
8. P1 makes 7 moves; P2 makes 2 moves

At this point, P2 sets a set of meeting places of Pink Senegal / Pink Plane / Pink Niger and Pink Niger / Car / Green Libya at the end of his sequence.
Meeting: Green Libya / Car / Pink Niger in the beginning

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 P1</td>
<td>None</td>
<td>P2</td>
<td>Pink</td>
<td>Self (44)</td>
<td>Self-play</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>2 P1</td>
<td>None</td>
<td>P2</td>
<td>Libya</td>
<td>Green</td>
<td>Self (53)</td>
<td>Entrance</td>
<td>Green Libya / None / None</td>
<td></td>
</tr>
<tr>
<td>3 P1</td>
<td>None</td>
<td>P2</td>
<td>Car</td>
<td>Self (51)</td>
<td>Connector</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>4 P1</td>
<td>Green Libya / None / None</td>
<td>P2</td>
<td>Pink</td>
<td>Self (46)</td>
<td>Exit</td>
<td>None</td>
<td>Green Libya / Car / Pink Niger / Complete</td>
<td></td>
</tr>
<tr>
<td>5 P1</td>
<td>Green Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Green</td>
<td>Self (2)</td>
<td>free-play</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>6 P2</td>
<td>None</td>
<td>P1</td>
<td>Car</td>
<td>Self (0)</td>
<td>free-play</td>
<td>None</td>
<td>Green Libya / Car / Pink Niger / Complete</td>
<td></td>
</tr>
<tr>
<td>7 P1</td>
<td>Green Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Green</td>
<td>free-play</td>
<td>Self (0)</td>
<td>Entrance</td>
<td></td>
</tr>
<tr>
<td>8 P1</td>
<td>Green Libya / None / None</td>
<td>P1</td>
<td>Car</td>
<td>free-play</td>
<td>Connector</td>
<td>Green Libya / Car / None / Complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 P1</td>
<td>Tasten Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Pink</td>
<td>Known (30)</td>
<td>free-play</td>
<td>Green Libya / Car / Pink Niger / Complete</td>
<td></td>
</tr>
<tr>
<td>10 P1</td>
<td>Green Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Pink</td>
<td>free-play</td>
<td>Self (0)</td>
<td>Exit</td>
<td></td>
</tr>
</tbody>
</table>

At this point in time, P1 has established a set of meeting places in the beginning of his journey of Green Libya / Car / Pink Niger. The game continues. More conversation about the meeting places occur at 01:30, but no changes are made.

P2 makes 1 move

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 P2</td>
<td>None</td>
<td>P2</td>
<td>Libya</td>
<td>Green</td>
<td>Self (53)</td>
<td>Entrance</td>
<td>Green Libya / None / None</td>
<td></td>
</tr>
<tr>
<td>3 P1</td>
<td>None</td>
<td>P2</td>
<td>Car</td>
<td>Self (51)</td>
<td>Connector</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>4 P2</td>
<td>None</td>
<td>P2</td>
<td>Pink</td>
<td>Self (46)</td>
<td>Exit</td>
<td>None</td>
<td>Green Libya / Car / Pink Niger / Complete</td>
<td></td>
</tr>
<tr>
<td>5 P1</td>
<td>Green Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Green</td>
<td>Self (2)</td>
<td>free-play</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>6 P2</td>
<td>None</td>
<td>P1</td>
<td>Car</td>
<td>Self (0)</td>
<td>free-play</td>
<td>None</td>
<td>Green Libya / Car / Pink Niger / Complete</td>
<td></td>
</tr>
<tr>
<td>7 P1</td>
<td>Green Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Green</td>
<td>free-play</td>
<td>Self (0)</td>
<td>Entrance</td>
<td></td>
</tr>
<tr>
<td>8 P1</td>
<td>Green Libya / None / None</td>
<td>P1</td>
<td>Car</td>
<td>free-play</td>
<td>Connector</td>
<td>Green Libya / Car / None / Complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 P1</td>
<td>Tasten Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Pink</td>
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<td>free-play</td>
<td>Green Libya / Car / Pink Niger / Complete</td>
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<tr>
<td>10 P1</td>
<td>Green Libya / Car / Pink Niger</td>
<td>P1</td>
<td>Libya</td>
<td>Pink</td>
<td>free-play</td>
<td>Self (0)</td>
<td>Exit</td>
<td></td>
</tr>
</tbody>
</table>

At this point in time, P2 has established a set of meeting places in the beginning of his journey of Green Libya / Car / Pink Niger. The game continues. More conversation about the meeting places occur at 01:30, but no changes are made.
<table>
<thead>
<tr>
<th>#</th>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
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<th>Resulting State</th>
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<tbody>
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<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (5)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
<td>None</td>
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<tr>
<td>2</td>
<td>None</td>
<td>P1</td>
<td>Senegal</td>
<td>Pink</td>
<td>Self (3)</td>
<td>Self (4)</td>
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<td>None</td>
</tr>
<tr>
<td>3</td>
<td>None</td>
<td>P1</td>
<td>Libya</td>
<td>Green</td>
<td>Self (5)</td>
<td>Self (3)</td>
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<td>None</td>
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<td>P1</td>
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<td>Green</td>
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<td>Self (4)</td>
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<td>P1</td>
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<td>Green</td>
<td>free-play</td>
<td>Self (44)</td>
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<td>None</td>
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<td>Pink</td>
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<td>12</td>
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<td>DR Congo</td>
<td>Green</td>
<td>Self (46)</td>
<td>free-play</td>
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<td>None</td>
<td>None</td>
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<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (47)</td>
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<td>Plane</td>
<td>Pink</td>
<td>Self (53)</td>
<td>Self (47)</td>
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<td>Green</td>
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<td>None</td>
<td>None</td>
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<tr>
<td>16</td>
<td>None</td>
<td>P1</td>
<td>DR Congo</td>
<td>Green</td>
<td>free-play</td>
<td>Self (46)</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>17</td>
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<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (47)</td>
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</tr>
<tr>
<td>18</td>
<td>None</td>
<td>P2</td>
<td>Niger</td>
<td>Pink</td>
<td>Self (48)</td>
<td>Self (51)</td>
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<td>None</td>
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<td>P1</td>
<td>Niger</td>
<td>Pink</td>
<td>known (30)</td>
<td>Self (6)</td>
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<td>None</td>
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<tr>
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<td>P1</td>
<td>Senegal</td>
<td>Pink</td>
<td>known (26)</td>
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<td>None</td>
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<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (55)</td>
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<td>Plane</td>
<td>Pink</td>
<td>Self (55)</td>
<td>Self (1)</td>
<td>Connector</td>
<td>Pink Senegal / Pink Plane / None</td>
<td>None</td>
</tr>
</tbody>
</table>

No Color-List

Female # 57

Meeting: Pink Senegal / Pink Plane / Pink Niger in the beginning

P1 makes 1 move in self

P1 says: Well, for now we'll go with green until something else comes up.

P1 makes 1 move to free-play

P2 makes 1 move in free-play

P1 makes 2 moves; P2 makes 13 moves

P1 makes 2 moves, P2 makes 2 moves

P1 makes 1 move in self

Players realize that they have pinks in common and decide to set them at the beginning.

P1 makes 1 move; P2 makes 2 moves

P1 makes 1 move (a discard)

Players realize that they have pinks in common and decide to set them at the beginning.

P1 makes 2 moves (to get cards out of the way)
At this point, P2 established a set of meeting places at Green Libya / Car / Pink Niger at the end of her sequence. P1 makes 1 move (from free-play to free-play).

At this point, P1 established a set of meeting places at Green Libya / Car / Pink Niger at the end of her sequence. The game continues. No more conversation about the meeting places occurs.
## Color-Name List

Meeting: pink Senegal / pink Plane / pink Niger at the end

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 P1</td>
<td>none</td>
<td>Niger</td>
<td>Pink</td>
<td>Known (30)</td>
<td>Self (9)</td>
<td>Entrance</td>
<td>pink Niger / none / none</td>
<td>Complete</td>
</tr>
<tr>
<td>3 P1</td>
<td>none / none / pink Niger</td>
<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (9)</td>
<td>Connector</td>
<td>none / pink Plane / pink Niger</td>
<td>Complete</td>
</tr>
</tbody>
</table>
### Color-List

**Female # 56**

**Meeting: Pink Niger / Pink Plane / Pink Senegal in the middle**

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>None</td>
<td>P1</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (9)</td>
<td>Self (8)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>P2</td>
<td>None</td>
<td>P2</td>
<td>Plane</td>
<td>Yellow</td>
<td>Down (29)</td>
<td>Self (9)</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P1 makes 1 move to free-play

| P1            | None   | P1     | Plane        | Pink           | Self (54)           | Self (50)   | None            | None   |
| P2            | None   | P2     | None         | None           | None                | None        | None            | None   |

P1 makes 1 move to free-play

| P1            | None   | P2     | Plane        | Pink           | Self (54)           | Self (50)   | None            | None   |
| P2            | None   | P2     | Plane        | Yellow         | Self (46)           | Self (53)   | None            | None   |

P1 makes 1 discard; P2 makes 3 moves

| P1            | None   | P1     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |

P1 makes 1 move; P2 makes 1 move

| P1            | None   | P2     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |

P2 makes 1 move

| P1            | None   | P2     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |

P2 makes 1 move to free-play

| P1            | None   | P1     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |
| P2            | None   | P2     | Senegal      | Pink           | Down (26)           | free-play   | None            | None   |

P1 makes 1 move

| P1            | None   | P2     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |

P2 makes 1 move

| P1            | None   | P1     | Plane        | Pink           | Self (50)           | free-play   | None            | None   |
| P2            | None   | P2     | Senegal      | Pink           | Self (46)           | free-play   | None            | None   |

P1 makes 2 moves

| P1            | None   | P2     | Plane        | Pink           | Self (4)            | Self (6)    | None            | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (4)            | Self (6)    | None            | None   |

P1 makes 1 move

| P1            | None   | P1     | Plane        | Pink           | Self (4)            | Self (4)    | None            | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (4)            | Self (4)    | None            | None   |

P1 makes 2 moves

At this point, the P1 is looking for a yellow Angola to complete their meeting places of Yellow Mali / Yellow Plane / Yellow Angola. They haven’t yet noticed the pink opportunities.

| P1            | None   | P2     | Senegal      | Pink           | Self (46)           | Self (50)   | Exit            | None   |
| P2            | None   | P2     | Senegal      | Pink           | Self (46)           | Self (50)   | None            | None   |

P1 makes 8 moves; P2 makes 3 moves

| P1            | None   | P2     | Plane        | Pink           | Self (4)            | Self (49)   | Connector       | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (49)           | Self (49)   | None            | None   |

P2 makes 1 move

P1 makes 1 move

| P2            | None   | P2     | Plane        | Pink           | Self (44)           | Self (49)   | Entrance        | None   |
| P2            | None   | P2     | Plane        | Pink           | Self (44)           | Self (49)   | Entrance        | None   |

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P2 makes 1 move

In this point, P1 has three meeting places of Pink Niger / Pink Plane / Pink Senegal established at the beginning of her sequence.

P1 makes 4 moves. The players are focusing on making yellow meeting places.

P1 makes 1 move to free-play

P2 makes 1 move

P1 makes 1 move; P2 makes 1 move

P1 makes 1 discard; P2 makes 3 moves

P1 makes 1 move to free-play

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 2 moves

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

In this point, P1 has three meeting places of Pink Niger / Pink Plane / Pink Senegal established at the beginning of her sequence.

P1 makes 4 moves. The players are focusing on making yellow meeting places.

P1 makes 1 move to free-play

P2 makes 1 move

P1 makes 1 move; P2 makes 1 move

P1 makes 1 discard; P2 makes 3 moves

P1 makes 1 move to free-play

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P1 makes 2 moves

P2 makes 1 move

At this point, the P1 is looking for a yellow Angola to complete their meeting places of Yellow Mali / Yellow Plane / Yellow Angola. They haven’t yet noticed the pink opportunities.

P1 makes 8 moves; P2 makes 3 moves

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

P1 makes 1 move

P2 makes 1 move

In this point, P1 has three meeting places of Pink Niger / Pink Plane / Pink Senegal established at the beginning of her sequence.
<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2 makes 1 move to free-play</td>
<td>1</td>
<td>P1</td>
<td>None</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (55)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>P1 makes 1 move to free-play</td>
<td>2</td>
<td>P1</td>
<td>None</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (9)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>P1 makes 1 move to free-play</td>
<td>3</td>
<td>P1</td>
<td>None</td>
<td>Plane</td>
<td>Yellow</td>
<td>Self (46)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>P1 makes 1 move to free-play</td>
<td>4</td>
<td>P1</td>
<td>None</td>
<td>Plane</td>
<td>Yellow</td>
<td>Known (29)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>P1 makes 1 move to free-play</td>
<td>5</td>
<td>P1</td>
<td>None</td>
<td>Mali</td>
<td>Yellow</td>
<td>free-play</td>
<td>Self (10)</td>
<td>None</td>
</tr>
<tr>
<td>P1 makes 3 moves to free-play</td>
<td>6</td>
<td>P1</td>
<td>None</td>
<td>Plane</td>
<td>Yellow</td>
<td>free-play</td>
<td>Self (9)</td>
<td>None</td>
</tr>
<tr>
<td>At this point, the players are trying to establish yellow meeting places at the end of None / Yellow Plane / Yellow Mali</td>
<td>7</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (44)</td>
</tr>
<tr>
<td>P1 makes 1 move to free-play; P2 makes 1 move to free-play</td>
<td>8</td>
<td>P1</td>
<td>None</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (3)</td>
<td>free-play</td>
<td>Senegal / None / None</td>
</tr>
<tr>
<td>P1 makes 1 discard</td>
<td>9</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (5)</td>
<td>free-play</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>P1 makes 3 moves to free-play</td>
<td>10</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (54)</td>
<td>free-play</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>P2 makes 4 moves to free-play</td>
<td>11</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Yellow</td>
<td>free-play</td>
<td>Self (53)</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>P1 makes 1 discard</td>
<td>12</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Yellow</td>
<td>free-play</td>
<td>Self (53)</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>P2 makes 1 move to free-play</td>
<td>13</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>free-play</td>
<td>Known (29)</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>At this point P1 has the meeting places of Pink Senegal / Pink Plane / Pink Niger at the beginning of his sequence. However, P1 does not yet consider this as meeting places.</td>
<td>14</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>Known (29)</td>
<td>free-play</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>P1 makes 2 moves; P2 makes 1 moves</td>
<td>15</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>free-play</td>
<td>Self (2)</td>
<td>Exit</td>
</tr>
<tr>
<td>P2 makes 2 moves to free-play</td>
<td>16</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>Unknown (26)</td>
<td>free-play</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>P2 makes 2 moves to free-play</td>
<td>17</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>free-play</td>
<td>Self (44)</td>
<td>Entrance</td>
</tr>
<tr>
<td>P1 makes 24 moves; P2 makes 22 moves</td>
<td>18</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>free-play</td>
<td>Self (45)</td>
<td>Connector</td>
</tr>
<tr>
<td>At this point P2 has the meeting places of Pink Senegal / Pink Plane / Pink Niger at the beginning of his sequence. The game continues and no more conversation about the meeting places occurs and no changes are made.</td>
<td>19</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>Unknown (26)</td>
<td>free-play</td>
<td>Senegal / Plane / None</td>
</tr>
<tr>
<td>P2 makes 2 moves to free-play</td>
<td>20</td>
<td>P1</td>
<td>Senegal / Plane / None</td>
<td>Plane</td>
<td>Pink</td>
<td>free-play</td>
<td>Self (46)</td>
<td>Exit</td>
</tr>
</tbody>
</table>
Meeting: pink Senegal / Car / Yellow Mali in the beginning

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1</td>
<td>None</td>
<td>Pink Senegal</td>
<td>Self (0)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P2</td>
<td>None</td>
<td>Car</td>
<td>Self (0)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

At this point, the players seem to be focusing on color.

P2 seems to be rejecting the idea of yellows linked by a plane because can't find a link.

| 2            | P1     | None        | Pink Senegal | Self (50)   | free-play          | None        | None           |        |
|              | P2     | None        | Car          | Self (50)   | free-play          | None        | None           |        |

At this point, P2 also established the same set of meeting places as P1 of pink Senegal / Car / yellow Mali. The game continues.

P1 moves 6 cards to free-play. P2 moves 12 cards in mostly free-play.

At this point, P2 also established the same set of meeting places as P1 of pink Senegal / Car / yellow Mali. The game continues.
<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P1</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (9)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (6)</td>
<td>Self (9)</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (5)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P1 makes 1 move from self to free-play.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
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<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (4)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Plane</td>
<td>Pink</td>
<td>Self (9)</td>
<td>Self (9)</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

The players are trying to get yellow meeting places at this point. They have not noticed the pink opportunities yet.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
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<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Plane</td>
<td>Yellow</td>
<td>Self (6)</td>
<td>free-play</td>
<td>None</td>
</tr>
<tr>
<td>12</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P2 makes 1 move in self.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Plane</td>
<td>Yellow</td>
<td>Self (9)</td>
<td>Self (9)</td>
<td>None</td>
</tr>
<tr>
<td>14</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>15</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Mali</td>
<td>Yellow</td>
<td>Self (3)</td>
<td>Self (10)</td>
<td>None</td>
</tr>
<tr>
<td>16</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P1 makes 3 moves (2 in self, 1 discard).

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Plane</td>
<td>Yellow</td>
<td>Self (4)</td>
<td>Self (8)</td>
<td>None</td>
</tr>
<tr>
<td>18</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P1 makes 3 moves to free-play. P1 is starting to put her pinks together without saying anything about it.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Plane</td>
<td>Yellow</td>
<td>Self (5)</td>
<td>Self (5)</td>
<td>None</td>
</tr>
<tr>
<td>20</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P1 makes 1 discard.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P1</td>
<td>Plane</td>
<td>Pink</td>
<td>free-play</td>
<td>Self (6)</td>
<td>None</td>
</tr>
<tr>
<td>22</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P1 makes 1 discard.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>P1</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Niger</td>
<td>Pink</td>
<td>known (25)</td>
<td>Self (2)</td>
<td>Exit</td>
</tr>
<tr>
<td>24</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

At this point, P1 has three meeting places of Pink Senegal / Pink Plane / Pink Niger established at the beginning of her sequence.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player Number</th>
<th>Name</th>
<th>Object Name</th>
<th>Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>P1</td>
<td>Pink Senegal / Pink Plane / Pink Niger</td>
<td>None</td>
<td>None</td>
<td>P2</td>
<td>Senegal</td>
<td>Pink</td>
<td>known (25)</td>
<td>free-play</td>
</tr>
<tr>
<td>26</td>
<td>P2</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

P2 makes 1 move to free-play to get a card out of the way.

P1 makes 1 move to free-play but not a card out of the way.
No Color-No List
Female # 55
Meeting: Green Lybia / Car / Pink Niger in the beginning

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1</td>
<td>None</td>
<td>P2</td>
<td>Libya</td>
<td>Self (53)</td>
<td>Self (52)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>P1</td>
<td>None</td>
<td>P2</td>
<td>Green</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>P1</td>
<td>None</td>
<td>P2</td>
<td>Pink</td>
<td>Self (44)</td>
<td>free-play</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>P1</td>
<td>None</td>
<td>P2</td>
<td>Pink</td>
<td>Self (44)</td>
<td>Entrance</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>P2</td>
<td>Green Libya</td>
<td>None</td>
<td>Connector</td>
<td>Self (45)</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>P2</td>
<td>Green Libya</td>
<td>None</td>
<td>None</td>
<td>Free-play</td>
<td>Self (46)</td>
<td>Exit</td>
<td>Complete</td>
</tr>
</tbody>
</table>

At this point, P2 established as set of meeting places of Green Libya / Car / Pink Niger at the end of his sequence.

<table>
<thead>
<tr>
<th>Initial State</th>
<th>Player</th>
<th>Object Name</th>
<th>Object Color</th>
<th>Object Origin</th>
<th>Object Destination</th>
<th>Object Role</th>
<th>Resulting State</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>P1</td>
<td>Green Libya</td>
<td>None</td>
<td>Green Libya</td>
<td>None</td>
<td>None</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>P2</td>
<td>Green Libya</td>
<td>Car</td>
<td>Green Libya</td>
<td>None</td>
<td>Connector</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>P1</td>
<td>Green Libya</td>
<td>Car</td>
<td>Pink</td>
<td>Green Libya</td>
<td>None</td>
<td>Complete</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>P2</td>
<td>Green Libya</td>
<td>Car</td>
<td>Pink</td>
<td>Green Libya</td>
<td>None</td>
<td>Complete</td>
<td></td>
</tr>
</tbody>
</table>

At this point, P1 established as set of meeting places of Green Libya / Car / Pink Niger at the end of his sequence. The game continues and there is some conversation about meeting places, but no changes to the sequence result.
REFERENCES


