

Van Hiele Levels of Pre- and In- Service Turkish Elementary School Teachers and Gender Related Differences in Geometry

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Abstract: This study aimed to investigate the reasoning stages of pre- and in-service elementary school teachers in geometry. A total of 186 pre-and in-service Turkish elementary school teachers participated in the study. The researchers used a multiple-choice geometry test to find out the participants' van Hiele levels. After the collection of the data, the independent samples t-test with $\alpha = .05$ was used in the analysis of the quantitative data. The study revealed that the pre- and in-service elementary school teachers showed the first four van Hiele levels, visualization, analysis, ordering and deduction in different percentiles and that there was no difference in terms of reasoning stages between the pre- and in-service elementary school teachers. Moreover, although there was no gender difference found regarding the geometric thinking levels between male and female in-service elementary school teachers, there was a gender difference detected with reference to reasoning stages between male and female pre-service elementary school teachers favoring males.

Key words: Pre- and in-service elementary school teachers; van Hiele levels; Elementary school; Geometry; Gender; Turkish mathematics education

Introduction

Over the past few decades, research has indicated that many students encounter difficulties and show poor performance in geometry (e.g., Fuys, Geddes, & Tischler, 1988; Gutierrez, Jaime, & Fortuny, 1991). Moreover, research demonstrates a decline in students' motivation toward mathematics courses (c.f., Gottfried, Fleming, & Gottfried, 2001). Usiskin (1982) shows that many students fail to grasp key concepts in geometry, and leave the geometry classes without learning basic terminology.

Furthermore, there are many factors, such as knowledge of teachers, gender, task difficulty, perception of cognitive competence, perception of parental support, environment, curriculum, and so on, seeming to play vital roles on student achievement and motivation in the mathematics classroom (e.g., Driscoll, 1994; Reeve, 1996; Wentzel, 1997; Middleton, 1999; Alderman, 1999; Chappell, 2003;

Young-Loveridge, 2005). It appears clear that all of these variables have effects on student learning but the role of a teacher has the greatest impact among others on student motivation and mathematics learning because of the fact that students spend most of their times at classrooms with their teachers (Stipek, 1998).

Researchers have argued that the quality of instruction has one of the greatest influences on the students' acquisition of geometry knowledge in mathematics classes (Burger & Shaughnessy, 1986; Geddes & Fortunato, 1993), and the students' progress from one level to the next in geometry also depends on the quality of instruction more than other factors, such as biological maturation or students' age, environment, parents' support, and peers' support (e.g., Crowley, 1987). Furthermore, according to Stipek (1998), teachers' content knowledge plays prominent roles in students' performance, and the pre- and in-service school teachers' inadequate geometry knowledge might be another important factor behind students' poor performance in geometry. This statement is consistent with the argument made by Mayberry (1983) and Fuys, Geddes, and Tischler (1988) who stated that content knowledge in geometry among pre-service and in-service teachers is not sufficient. Therefore, these arguments might be clearly explained by finding the van Hiele levels of pre- and in-service elementary school teachers in geometry.

The van Hiele Theory

Since the mid 1980s there has been a growing interest in the area of teaching and learning geometry (e.g., Crowley, 1987; Gutierrez, Jaime, & Fortuny, 1991; Clements & Battista, 1990; Mason, 1997; Lappan, Fey, Fitzgerald, Friel, & Phillips, 1996). The National Council of Teacher of Mathematics (NCTM) (2000) recommends that new ideas, strategies, and research findings be utilized in teaching in order to help students overcome their difficulties in learning mathematics. Knowing theoretical principles provides an opportunity to devise practices that have a greater possibility of succeeding (e.g., Swafford, Jones, & Thornton, 1997).

The van Hiele model of thinking that was structured and developed by Pierre van Hiele and Dina van Hiele-Geldof between 1957 and 1986 focuses on geometry. The van Hieles described five levels of reasoning in geometry. These levels, hierarchical and continues, are Level-I (Visualization), Level-II (Analysis), Level-III (Ordering or Informal Deduction), Level-IV (Deduction), and Level-V (rigor) (Van Hiele, 1986).

For this article, all references and all results from research studies using the 0-4 scale have been changed to the I-V scheme.

Descriptions of van Hiele levels

Level-I: Visualization or Recognition. At this level students recognize and identify geometric figures according to their appearance, but they do not perceive the properties or rules of figures. When students call a figure a square, they react to the whole figure and not to specific parts or properties of the square such as right angles, equal side lengths and equal diagonals. For example, they can identify a square, and they can recognize it very easily because of its shape, which looks like the shape of a window or the shape of a frame (e.g., Hoffer, 1988; Fuys, Geddes, & Tischler, 1988).

Level-II: Analysis. At this level students analyze figures in terms of their components and relationships among components and perceive properties or rules of a class of shapes empirically, but properties or rules are perceived as isolated and unrelated. What was implicit for the students at previous level, Visualization, becomes explicit now. For instance, their analysis may assert that opposite sides of a rectangle are congruent and all of its angles are right angles. Students can also identify and name geometric figures by knowing their properties. For example, they can easily choose the right geometric figures among others if a figure is described as one with each pair of sides parallel. Although at this level the students are able to acknowledge various relationships among the parts of the figures, they do not perceive any relationship between squares and rectangles or rectangles and parallelograms (e.g., Hoffer, 1988; Fuys, Geddes, & Tischler, 1988).

Level-III: Ordering or Informal Deduction. At this level students logically order and interrelate previously discovered properties and rules by giving informal arguments. Logical implications and class inclusions are understood and recognized. At this level the students are able to see the relationships among the geometric figures. For example, they can easily say that a square is also a rectangle and a rectangle is also a parallelogram. The relationships among different types of figures, which may have been implicit at Level-II (Analysis) for the students, are now very explicit (e.g., Hoffer, 1988; Fuys, Geddes, & Tischler, 1988).

Level-IV: Deduction. At this level students analyze relationships of systems between figures. They can prove theorems deductively, construct proofs, and they can understand the role of axioms and definitions. A student should be able to supply reasons for steps in a proof. In other words, “the students can follow the line of argument in proofs of statements presented to them, and they can develop sequences of statements to deduce one statement from another. What may have been an implicit understanding at previous level, Ordering, of why certain statements were true (the level at which students might say, “I think I understand it,

but I can't explain it") now develops into reasoning patterns that enable the students to create sequences of statements to formally explain, that is, prove why the statement is true" (Hoffer, 1988, p. 239).

Level-V: Rigor. At this level students are able to analyze various deductive systems like establishing theorems in different axiomatic systems, and they can compare these systems. A student should be able to know, understand and give information about any kind of geometric figures (e.g., Hoffer, 1988; Fuys, Geddes, & Tischler, 1988).

Although the existence of Level-0 is the subject of some controversy (e.g., Usiskin, 1982; Burger & Shaughnessy, 1986), van Hiele (1986) does not talk and acknowledge the existence of such a level. However, Clements and Battista (1990) talked about the existence of a Level-0 called pre-recognition. Clements and Battista (1990) have described and defined **Level-0 (Pre-recognition)** as "Children initially perceive geometric shapes, but attend to only a subset of a shape's visual characteristic. They are unable to identify many common shapes" (p. 354). For example, learners may see the difference between triangles and quadrilaterals by focusing on the number of sides the polygons have but not be able to distinguish between any of the quadrilaterals (Mason, 1997). In other words, the main difference between pre-recognition and visualization is that the students at Level-I (Visualization) can easily say "this is a square, this is a rectangle or this is a parallelogram based on the appearance of the figure, but the ones who are at Level-0 (Pre-recognition) are not able to see the differences among the quadrilaterals based on the appearance of the figures.

Empirical research on the van Hiele theory

There have been many studies completed on various components of this teaching and learning model at different school levels since it was proposed. For example, Wirzup (1976) described several studies and introduced the van Hiele theory in the US. His works took the attention of the educators and researchers. There were three major projects initiated in the US dealing with the different components of the theory (e.g., Usiskin, 1982; Fuys, Geddes, & Tischler, 1988).

The findings of these projects were reported and shared with the educators. For instance, Hoffer (1988) described and identified each van Hiele level, Burger and Shaughnessy (1986) focused on the characteristics of the van Hiele levels of development in geometry, Usiskin (1982) affirmed the validity of the existence of the first four levels in geometry at the high school level, and Fuys, Geddes, and Tischler (1988) examined the effects of instruction on a student's predominant van Hiele level. These research findings help mathematics teachers systematize their

geometric thinking and understand how the students think and what sort of difficulties they face in learning geometry. Several textbook writers write their geometry sections or books based on the van Hiele theory, such as Michael Serra's geometry book and Connected Mathematics Projects' "shapes and designs" (Serra, 1997).

Moreover, there were some studies done with middle, high and college level students in order to find out their van Hiele reasoning stages in geometry. For instance, Burger and Shaughnessy (1986) and Halat (2006, 2007) found mostly Level-I (Visualization) reasoning in grades K-8 while Fuys et al. (1988) found no one performing above Level-II (Analysis) in interviewing sixth and ninth grade average and "above average" students, which supports the idea that most younger students and many adults in the United States reason at Level-I (Visualization) and Level-II (Analysis) of van Hiele theory (Usiskin, 1982; Hoffer, 1988). Both middle and high school students do not meet the expectations of NCTM (2000). Middle school students are supposed to have Level-II (Analysis) geometry knowledge at the end of eighth grades. Likewise, high school students should be able to prove theorems. In other words, at least they should complete Level-III (Ordering or Informal Deduction). However, the research findings mentioned above are not consistent with the expectations of NCTM. High school teachers often complain about the students' poor geometry knowledge that is not adequate to start high school geometry. Chappell (2003) explains this issue with the in-service middle school mathematics teachers' insufficient geometry knowledge.

Furthermore, According to Gutierrez, Jaime, and Fortuny (1991), Duatepe (2000) and Knight (2006), the pre-service elementary school mathematics teachers' reasoning stages were below Level-III (informal deduction) (in Spain, Turkey, and USA respectively). Likewise, Mayberry (1983) who conducted a study with pre-service elementary school teachers in USA stated that the pre-service elementary school teachers involved in her study were not at a suitable level to understand formal geometry, and that the instruction they had taken had not brought them to Level-IV (Deduction). Therefore, it is clear that the Elementary Education Departments at universities should check and update their programs based on the research findings.

There were also a couple of studies done with pre-service secondary mathematics teachers. For instance, Knight (2006) conducted a study with pre-service secondary and elementary mathematics teachers. She found that the pre-service secondary and elementary mathematics teachers reasoning stages were below Level-IV (Deduction) and Level-III (Informal Deduction), respectively. Her findings are surprising because the van Hiele levels of pre-service secondary and elementary

mathematics teachers are lower than the level expected of students completing grade 12 and grade 8, respectively. These results are in line with the findings of Gutierrez, Jaime, and Fortuny (1991), Mayberry (1983), Duatepe (2000), and Durmuş, Toluk, and Olkun (2002). In other words, none of the pre-service elementary and secondary mathematics teachers demonstrated a Level-V (Rigor) reasoning stage in geometry.

In short, most of these studies mentioned above were done with middle, high and college level students and mostly they examined students' van Hiele reasoning stages in geometry. This current study will examine the pre-and in-service elementary school teachers' geometric reasoning stages.

Gender Differences in Mathematics

Forgasız (2005), for whom gender is still a matter of concern in mathematics education argued that it is significantly important to include gender as a variable in research analysis even if it is not the main focus of a study. According to Armstrong (1981), Ethington (1992), Grossman and Grossman (1994), and Lloyd, Walsh and Yailagh (2005), gender is an important factor in learning mathematics. These arguments motivated the researcher to examine this variable in this current study.

Over the past few decades, research has shown that there is a difference between the achievement of male and female students in many content areas of mathematics, such as spatial visualization, problem solving, computation, measurement applications and so forth (e.g., Jones, 1989; Grossman & Grossman, 1994; Lloyd, Walsh & Yailagh, 2005). For instance, according to Armstrong (1981), female students performed better at computation and spatial visualization than males. However, according to Fox and Cohn (1980), there was a significant sex difference in mathematics achievement at the high school level. Males' performance was better than that of females on the Scholastic Aptitude Test in mathematics. Similarly, Smith and Walker (1988) found that there were statistically significant sex-related differences in favor of male students in geometry at the tenth grade level.

However, in recent years a considerable decrease can be seen in the gender gap between male and female students' attitudes towards mathematics (e.g., Friedman, 1994; Fennema & Hart, 1994). For example, Fennema and Hart (1994) claimed that interventions could achieve equity in learning mathematics. Likewise, according to Halat (2006), instruction influenced by the van Hiele theory-based curricula may cause changes in girls' negative attitudes towards mathematics courses because reform-based works in mathematics teaching and learning, such as the New Zealand Numeracy Projects (NZNP) (Young-Loveridge, 2005) and standard-based curricula,

such as “Everyday Math” and “MathThematics” have positive impacts on student achievement and motivation in mathematics (e.g., Billstein & Williamson, 2003; Chappell, 2003).

According to Hyde, Fennema and Lamon (1990) and Malpass, O’Neil and Hocevar (1999), there is also a considerable increase in the gender gap among gifted or high scoring students on mathematics tests. There are many factors, such as prior achievement, value, stereotyping mathematics as a male domain, parental support, teacher-care, peer-support, instruction, and curriculum appearing to play vital roles in the sex differences between boys and girls in mathematics (e.g., Becker, 1981; Ethington, 1992; Grossman & Grossman, 1994; Fan & Chen, 1997).

In short, it is clear that gender is an important factor affecting student performance in mathematics and research findings are varied in this issue.

Purpose of the Study

This current study focuses on the van Hiele levels of pre- and in-service elementary school teachers in geometry. The following questions guided this study:

1. What are the reasoning stages of pre- and in-service elementary school teachers in geometry?
2. What differences exist in terms of reasoning stages between the pre-service and in-service elementary school teachers?
3. Is there a difference in terms of geometric thinking levels between male and female pre- and in- service elementary school teachers?

We agree with the recommendation of NCTM (2000) that new educational theories and strategies should be utilized in teaching and learning geometry in order to help students overcome their difficulties in mathematics, in particular the van Hele theory for geometry. Many researchers have studied and confirmed different aspects of the van Hiele theory since proposed by the van Hieles. The present study adds to the set of studies by examining the geometric reasoning stages of pre- and in-service elementary school teachers.

Method

Participants

There were a total of 186 pre- and in-service elementary school teachers involved in this study. The number of pre-service elementary school teachers was 82 consisting of 34 (41%) male and 48 (59%) female. The number of in-service elementary school teachers was 104 including 61 (59%) male and 43 (41%) female. The pre-

service elementary school teachers completed the third year of their college years. The in-service elementary school teachers had different years of teaching experience from 1 to 21 years at public schools. This study took place in a city, Afyonkarahisar, located in the west part of Anatolia in Turkey.

In this study the researchers followed the “convenience” sampling procedure defined by McMillan (2000), where a group of participants is selected because of availability. The pre-service elementary school teachers who enrolled the mathematics learning course were from Afyon Kocatepe University. They are about the national average. The in-service elementary school teachers involved in this study teach at elementary schools in Afyonkarahisar.

Data sources

The data was collected during the spring of 2006. The researchers gave the pre- and in-service elementary school teachers a geometry test called *Van Hiele Geometry Test (VHGT)* that consists of 25 multiple-choice geometry questions. While the pre-service elementary school teachers took the Van Hiele Geometry Test (VHGT) in their classes at the end of the spring semester, the in-service elementary school teachers took the VHGT at their work places during the school day.

The VHGT was administered to the participants by the researchers. The VHGT was taken from the study of Usiskin (1982). The VHGT is designed to measure one’s van Hiele level in geometry. In this area, it is a well-known geometry test and it has been used in several Masters and PhD Dissertations since it was developed. This test was translated to Turkish language by the investigators. Five mathematicians reviewed Turkish version of VHGT in terms of its language and content.

Test scoring guide

In this study, the I-V scheme was used for the levels. This scheme allows the researchers to use Level-0 (pre-recognition) for students who do not function at what the van Hieles named the ground or basic level (Clements & Battista, 1990). It is also consistent with Pierre van Hiele’s numbering of the levels. For this report, all references and all results from research studies using the 0-IV scale have been changed to the I-V scheme.

All participants’ answer sheets from VHGT were read and scored by the investigators. All participants got a score referring to a van Hiele level from the VHGT guided by Usiskin’s grading system, as indicated below (Usiskin, 1982, p. 22).

For van Hiele Geometry Test, a student was given or assigned a weighted sum score in the following manner:

- 1 point for meeting criterion on items 1-5 (Level-I, Visualization);
- 2 points for meeting criterion on items 6-10 (Level-II, Analysis);
- 4 points for meeting criterion on items 11-15 (Level-III, Ordering);
- 8 points for meeting criterion on items 16-20 (Level-IV, Deduction);
- 16 points for meeting criterion on items 21-25 (Level-V, Rigor).

Analysis of Data

The data were responses from the pre- and in-service elementary school teachers' answer sheets. In the process of the assessment of participants' van Hiele levels, the criterion for success at any given level was four out of five correct responses. At the beginning of the analysis, the investigators constructed a frequency table to acquire information about the participants' van Hiele level distributions. And then, the independent samples t-test statistical procedure with $\alpha = .05$ was used to compare the geometric thinking levels of the pre-service elementary school teachers with the in-service elementary school teachers, and reasoning stages of male with female for both the pre-and in-service elementary school teachers.

Results

1. What are the reasoning stages of pre-and in-service elementary school teachers in geometry?

Table 1 demonstrating the level distribution of pre- and in-service elementary school teachers reasoning stages in geometry indicates that the participants showed the first four van Hiele levels in different percentiles. Although most of the pre-service elementary school teachers' reasoning stages were Level-I (Visualization) (34.1%), Level-II (Analysis) (37.8 %), and Level-III (Ordering) (25.6 %), none of the pre-service elementary school teachers performed Level-IV (Deduction) and Level-V (Rigor) geometry knowledge on the van Heile Geometry Test (VHGT). Likewise, according to Table 1, none of the in- service elementary school teachers showed Level-V (Rigor) reasoning stage on the test. However, even though 20.2 percent of them interestingly attained Level-0 (Pre-recognition), a small percentile showed Level-IV (Deduction) geometry knowledge that is interesting because this level of geometric thinking is expected from pre- or in-service middle or high school mathematics teachers, not from the in-service elementary school teachers. Mostly they attained Level-I (Analysis) (27.9 %) and Level-II (Analysis) (37.5 %).

Table 1
Frequency for Pre- and In-Service Elementary School Teachers' van Hiele Levels

Groups	N	Level-0		Level-I		Level-II		Level-III		Level-IV		Level-V	
		<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)	<i>n</i>	(%)
A	82	2	2.4	28	34.1	31	37.8	21	25.6	0	0	0	0
B	104	21	20.2	29	27.9	39	37.5	11	10.6	4	2.8	0	0
Total	186												

Note: Level-0 (Pre-recognition), Level-I (Visualization), Level-II (Analysis), Level-III (Ordering), Level-IV (Deduction), Level-V (Rigor). A: Pre-service elementary school teacher; B: In-service elementary school teacher.

2. What differences exist in terms of reasoning stages between the pre-service and in-service elementary school teachers?

According to Table 2, the mean score of the pre-service elementary school teachers' van Hiele levels (1.87) was numerically higher than that of the in-service elementary school teachers (1.50). The mean score difference in terms of reasoning stages was not statistically significant [$t = 2.65$, $p = .14 > .05$]. This means that statistically there is no difference as in geometric thinking levels between the pre- and in-service elementary school teachers.

Table 2
Descriptive Statistics and the Independent Samples T-Test for Pre- and In-Service Elementary School Teachers' van Hiele Levels

Groups	N	van Hiele Geometry Test				
		M	SD	df	t	p
A	82	1.87	.82	184	2.65	.14
B	104	1.50	1.05			
Total	186					

Note. A: Pre-service elementary school teacher; B: In-service elementary school teacher.

3. Is there a difference in terms of geometric thinking levels between male and female pre- and in- service elementary school teachers?

Table 3 presents the descriptive statistics for the pre- and in-service elementary school teachers' van Hiele levels, and indicates that the male pre-service elementary school teachers' mean score (2.09) is numerically higher than that of the females (1.71). According to the independent samples t-test, the mean score differences between male and female pre-service elementary school teachers on the van Hiele

Geometry Test (VHGT) is statistically significant [$t= 2.10, p=.03 < .05$]. In other words, there is gender difference regarding the geometric thinking levels between male and female pre-service elementary school teachers favoring males.

On the contrary, Table 3 shows that the female in-service elementary school teachers' mean score (1.65) is numerically higher than that of the males (1.39). However, this difference is not statistically significant [$t= 1.26, p=.21 > .05$].

Table 3
Descriptive Statistics and the Independent Samples T-Test for Pre- and In-Service Elementary School Teachers' van Hiele Levels by Gender

Gender	N	Van Hiele Geometry Test				
		M	SD	df	t	p
Male (A)	34	2.09	.79	80	2.10	.03
Female (A)	48	1.71	.82			
Total	82					
Male (B)	61	1.39	1.10	102	1.26	.21
Female (B)	43	1.65	.97			
Total	104					

Note. A: Pre-service elementary school teacher; B: In-service elementary school teacher.

Discussion and Conclusion

This study documented that pre-and in-service elementary school teachers showed first three reasoning stages described by the van Hiele levels in different percentiles. Most of the participants' van Hiele levels were at Level-I (Visualization), Level-II (Analysis) and Level-III (Ordering). In order to teach geometry successfully at elementary schools, the expected geometric reasoning stage for the elementary school teachers is Level-III (Ordering) or above (Hoffer, 1988; YOK, 2007). However, this study found that almost 74% of pre-service elementary school teachers and 86% of the in-service elementary school teachers' van Hiele levels were below Level-III (Ordering).

The mean scores of both groups' van Hiele levels indicate that the participants completed Level-I (Visualization) thinking and in the acquisition of Level-II (Analysis). This implies that both pre-and in-service elementary school teachers' geometry knowledge is not sufficient to teach at elementary schools. Moreover, one fifth of the in-service elementary school teachers attained Level-0 (Pre-recognition). This level of thinking is not expected from the first grade students (NCTM, 2000; Altun, 2005). This result is consistent with the claim of Usiskin (1982) and Hoffer

(1988) that most younger students and many adults in the United States reason at Level-I (Visualization) and Level-II (Analysis) of van Hiele theory.

The study also revealed that both pre- and in-service elementary school teachers showed almost equal performance on the van Hiele geometry test. Their reasoning stages are lower than what is expected of them. It appears that the main reason behind their low geometry knowledge might be not getting good education from their universities. Therefore, Elementary Education Departments in universities should check their programs and offer high-level geometry courses to their students.

Furthermore, the study found that although the mean score of female in-service elementary school teachers' van Hiele levels is higher than that of males, this difference was not statistically significant. In other words, both female and male in-service elementary school teachers performed equally on the test. This result supports the finding of research (e.g., Friedman, 1994; Fennema & Hart, 1994; Halat, 2006) claiming that in recent years a considerable decrease can be seen in the gender gap between males and females' attitudes toward the mathematics.

However, there was a difference found in regard to reasoning stage between male and female pre-service elementary school teachers. This is in favor of males. In other words, male pre-service elementary school teachers performed better than female pre-service elementary school teachers on the van Hiele geometry test. This finding is consistent with the result of research (e.g., Jones, 1989; Grossman & Grossman, 1994; Lloyd, Walsh & Yailagh, 2005) stating that there is a difference between the achievement of males and females in many content areas of mathematics, such as spatial visualization, problem solving, computation, measurement applications and so forth.

In short, the study concluded that there was no difference found between the pre- and in- service elementary school teachers' geometric reasoning stages. More importantly, it revealed that both pre- and in-service elementary school teachers' van Hiele levels are inadequate to teach geometry successfully at elementary school level. In addition, although female in-service elementary school teachers showed better performance on the test than that of males, male pre-service elementary school teachers' van Hiele levels were numerically higher than that of females.

Limitations and Future Research

According to Mayberry (1983), a person can attain different levels for different concepts. Similarly, Burger and Shaughnessy (1986) found that students may exhibit different levels of reasoning on the tasks. As the topic of the study was

quadrilateral, the findings of the study should not be generalized to all geometry topics. Furthermore, the results of the study should not be generalized to all pre- and in-service elementary school teachers.

It would be interesting to see further research studies done with pre- and in-service elementary school teachers in different places and countries in order to get in-depth information about the van Hiele reasoning stages of them. Furthermore, one of the findings of this current study about gender is lined up with result of the studies claiming that gender gap is increasing from middle school years through the university years (Fox and Cohn, 1980; Smith & Walker, 1988; Malpass, O'Neil & Hocevar, 1999). One would conduct a research study to examine this contradiction and find possible explanations to it.

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