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Gender and Gender Identity Differences in Learning Styles

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ABSTRACT *In the past decade, extensive research on gender and learning styles has produced a multitude of findings: gender differences in learning styles are small on average, but across studies quite different results are observed. In the present study, this heterogeneity is the central focus of our attention. Two possible interpretations concerning the educational context and the concept of gender identity are investigated: the teacher and the subject he or she teaches. Besides the variable gender as a dichotomous variable, the variable gender identity is included to reflect the theoretical standpoint of the social construction of gender differences. Using multivariate techniques on a data set of 432 adult secondary students, the observed relations between gender, gender identity and learning styles are described. Gender identity turns out to explain more variance in the use of learning styles compared to gender. Furthermore, it is shown that gender (identity) differences in learning styles do not vary across teachers and, with one exception, they do not vary across subjects.*

One of the most striking differences between women and men in education concerns the choices women and men make to study particular subjects. The Arts still seem to attract far more women, whereas more men still choose to study the Sciences. Considering, for example, the fact that women's school careers lead to less opportunities in the labour market than those of men, it is important to search for factors which are related to the study choices of women and men. School-internal factors, such as teaching methods and the content of education, have usually been the focus of this search for the explanation of gender differences. (Chipman *et al.*, 1985; Burton, 1990; Fennema & Leder, 1990; Volman *et al.*, 1995). In the past decade, a considerable number of researchers have used the concept of learning styles to investigate gender differences in education (Richardson & King, 1991; Severiens & ten Dam, 1994). Attempts have also been made to explain gender differences in study choices, by

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searching for differences in learning styles (Dippelhofer-Stiem, 1989). The concept of learning styles will be the central focus of the present study.

Results of the studies undertaken into gender and learning styles do not provide us with a clear view. In Severiens and ten Dam (1994), besides a narrative review, a meta-analysis was performed on two important instruments in this field: Kolb's Learning Style Inventory (Kolb, 1984) and Entwistle's Approaches to Studying Inventory (Entwistle, 1981). The aim was to outline a more coherent picture of possible gender differences in learning styles. Meta-analysing Kolb's Learning Style Inventory resulted in a small, but consistent, gender difference: men showed a greater preference than women for the abstract conceptualisation mode of learning. On Entwistle's Approaches to Studying Inventory, small consistent gender differences appeared on the scales for fear of failure, extrinsic and intrinsic motivation. Women experience more anxiety about their study success compared to men. Furthermore, men seem to be more often interested in the courses for the qualifications they offer and women, by contrast, are more often interested in learning for learning's sake. The conclusion of this meta-analysis was that, across studies, the mean gender difference in learning styles is small, but between-studies gender differences vary a great deal and are sometimes contradictory. For example, in the studies of Miller *et al.* (1990) and Richardson (1990) men score higher on the deep approach to studying. In two other studies, however, the opposite result was observed: women more often use the deep approach to studying (Watkins & Hattie, 1981; Coles, 1985). The variety of research outcomes also occurs in other areas: similar findings are reported by Hyde *et al.* (1990). They performed a meta-analysis on 100 studies on gender differences in mathematics performance. Overall mean differences were very small, while in higher education, for example, differences between women and men were quite large.

The heterogeneity of gender differences across studies can be interpreted in at least two ways. Firstly, a probable cause might concern the different contexts in which the studies were performed. A great variety of settings appears in research on gender and learning styles: different countries, different subjects, etc. Gender differences might very well vary according to the context. In the meta-analysis, however, there were not enough studies, nor enough background information, available (e.g. on type of education, subject or instructional strategies) in order to test which contextual characteristics matter most. But looking at the different studies on gender and learning, it is possible to distil possible relevant context-related factors. Watkins and Hattie (1981) observed an interaction effect of gender and field of study: differences between learning styles of women and men vary across the subjects the students study. Another aspect of the context that might be related to the way students study concerns the teacher. Quite a number of studies have shown that teachers address students in ways that vary according to gender (e.g. Stanworth, 1981; Walkerdine, 1987). These gendered ways of addressing students may also be related to the learning styles of female and male students. In the present study, we intend to investigate relations between the educational context and the learning styles of women and men in more detail by including two aspects: the teacher and the subject he or she teaches.

The second interpretation of the heterogeneity of gender differences across studies concerns the concept of gender itself. In all studies we are familiar with, gender is either male or female, the distinction is made between 'biological' women and men. Turning to the interpretation of the results in these studies, the explanation of observed differences usually is not focused on biological differences between women and men. Instead, gender differences in learning styles are often interpreted as a result of

		femininity	
		high	low
masculinity	high	androgynous	masculinity
	low	femininity	undifferentiated

FIG. 1. The gender identity typology.

socialisation processes which occur throughout a person's lifetime and also take place in the context of education. At this point, one could ask whether gender as a (dichotomous) biological variable is the concept we are looking for. Prevailing ideas on what women and men should be or how they should behave and ideas about femininity and masculinity should also be taken into account. These ideas find their way into the manner in which students perceive themselves in terms of gender. Outside school (e.g. in the family) as well as in school, students learn to think about themselves as women or men. In other words, they develop a gender identity by participating in cultural settings (ten Dam & Volman, 1995). Gender identity might offer a possibility to clarify gender-related processes in educational practice in more detail.

The concept of gender identity has been subject to many discussions, especially in the last few decades. Bem (1974) introduced the idea of two independent dimensions in this concept, as opposed to gender identity as a unidimensional concept with femininity and masculinity at the opposite ends. In her theory on gender identity, the two dimensions of femininity and masculinity are essentially uncorrelated. Individuals can describe themselves both in terms of masculine attributes and feminine attributes and a median-split method results in a typology of four categories (see Fig. 1). Androgynous individuals use both feminine and masculine attributes to describe themselves; undifferentiated individuals do not characterise themselves by either of these attributes. Feminine individuals use the feminine attributes and not the masculine, and the opposite is valid for masculine individuals. More recently, Ashmore (1990) has been arguing that there is more to gender identity than just personality attributes or traits. He proposes a multiplicity model of gender identity in which gender identity is considered to consist of multiple components, such as personality attributes, aspects of physical appearance, interests, abilities and social roles. The typology of Bem in itself is still applicable, however.

The two interpretations of the problem of heterogeneity concerning the educational context and the concept of gender identity are investigated in the present study. In terms of research questions:

(1) To what extent are learning styles related to gender, on the one hand, and gender identity, on the other?
(2) Do the relations between gender (identity) and learning styles differ across teachers and across subjects?

It is difficult to formulate hypotheses, because, to our knowledge, there is no former research in case of Question 1 and very little research in case of Question 2. Nevertheless, we would like to express some careful expectations. Because the variable of gender identity means a fine-tuning of gender as a dichotomous variable, the correlation between gender identity and learning styles might be larger compared to the correlation between gender and learning styles. As for Question 2, we expect the interaction effect

between gender and the arts subjects versus the science subjects as observed in Watkins and Hattie's study (1981) to turn up in our study as well. Watkins and Hattie do not elaborate on what particular difference between women and men appears in which subject and on which learning style. Therefore, we will explore all possible relations between subject, gender (identity) and learning styles.

Method

Subjects

Six schools of secondary adult education participated in this study: 432 students completed a learning styles questionnaire and a gender identity questionnaire. The students were asked to answer the questions within the context of a particular subject: this was either Dutch (25%), mathematics (29%), biology (21%) or history (25%). The resulting four groups are similar in terms of gender identity, but not in terms of numbers of women and men, nor age. In the analyses these differences will be accounted for by considering the main effects while partialling out the relevant interaction effects. Of the 432 students in the study, 58% are female and 42% are male. Nationwide the female–male ratio in secondary adult education is 62%–38% (CBS, 1991). Ages in our sample vary from 16 to 71 years, but the distribution is skewed: 75% are between 16 and 22. This considerable range of ages had led us to analyse the age effects along with the other effects. Besides, in a number of studies age effects in learning styles were observed (among others, Vermunt & van Rijswijk, 1988), providing another reason to analyse the (interaction) effects of age. The data matrix has a hierarchical structure; in other words, it consists of two levels: 432 students within 58 teachers (63% female and 35% male). The number of students per teacher varies from one to 25, with a mean number of seven students.

Instruments

The instruments we used were the Inventory of Learning Styles (ILS) (Vermunt & van Rijswijk, 1988) and the Dutch Sex Role Inventory (NSRV) (Willemsen & Fischer, 1992). Vermunt and van Rijswijk define learning styles in a broad sense: learning styles involve processing strategies, regulation strategies, learning orientations and learning conceptions. The questionnaire consists of 120 items, divided into 20 subscales (see Table I). Combinations of these scales produce four different learning styles: the reproduction-directed learning style, the meaning-directed learning style, the application-directed learning style and the undirected learning style (Vermunt, 1992). The internal consistencies of the scales of this instrument are quite acceptable, Cronbach's α varies from 0.70 to 0.95 (Vermunt & van Rijswijk, 1988). In the present sample of students α varies from 0.65 to 0.89.

Willemsen and Fischer (1992) took Ashmore's multiplicity model as a starting point in the construction of the Dutch Sex Role Inventory. In the first part, the inventory includes 30 items on attributes and in the second part 28 items on physical appearance, interests, abilities, social relationships and gender-role behaviour. The items reflect stereotypical beliefs about women and men in our society. Each respondent receives two scores: one for feminine gender identity (a combination of feminine attributes and interest, abilities, etc.) and one for masculine gender identity (a combination of masculine attributes and interests, abilities, etc.) This questionnaire also produces

acceptable reliability scores: an α of 0.67 on the scale for feminine gender identity and 0.72 on the scale for masculine gender identity. In our sample, these scores turn out higher: 0.76 on feminine gender identity and 0.80 on masculine gender identity. Gender and gender identity are related in the expected directions in our data set: women score higher on the dimension of feminine gender identity, $F(1,424) = 112.6$, $p < 0.00$, and men score higher on masculine gender identity, $F(1,425) = 48.3$, $p < 0.00$.

Learning Styles in the ILS

According to the original analyses of the ILS, combinations of scales result in four discernable learning styles (Vermunt, 1992). The meaning-directed learning style is characterised by deep processing strategies, self-regulation, a mental model of construction of knowledge and a 'personally interested' learning orientation. The reproduction-directed learning style consists of stepwise processing strategies, external regulation, an 'intake of knowledge' mental model, and certificate and vocation learning orientations. Students with the application-directed learning style often use concrete processing strategies, external regulation, they aim at using the knowledge they obtain and are personally interested. The fourth learning style is the undirected learning style. This style is characterised by a lack of regulation, ambivalence and a preference for stimulating education.

To verify this pattern of styles in the present sample of students, the scales of the ILS are analysed in a principal components analysis with four factors (after checking the most important statistical assumptions of multivariate methods [1]). In Table I, the factor loadings in our data set are shown. The patterns are similar to the ones found in the study by Roosendaal and Vermunt (1993) on high school students, except for the application-directed learning style. The first factor represents the meaning-directed learning style and the second factor the reproduction-directed learning style. These learning styles consist of exactly the same scales as in the study of Roosendaal and Vermunt. The fourth factor can be interpreted as the undirected learning style. The third factor which should represent the application-directed learning style does not appear in our sample of students. High loadings are obtained by use of knowledge, stimulating education and the self-test and vocation-orientated learning orientations. The use of knowledge would point at the application-directed learning style, but the other scales do not confirm this. However, this third style can be interpreted as a learning style typical of secondary adult education. Students in this type of education either try to pass their exams a second time (after failing in regular education) or they go back to school after many years. Either way, they are eager to show they can do it and expect to be stimulated by their teachers. The younger students are especially interested in moving on to a job or higher education, explaining the loading of the vocation-orientated learning orientation. Because the most typical aspect of this style seems to be showing that you can do it, we call the learning style of this group of students the 'prove yourself' directed learning style.

In the subsequent analyses, the (regression) factor scores (of the first four factors) will serve as the dependent variables representing the respective four learning styles.

Analyses

Two separate analyses are carried out to assess the effects of gender, on the one hand, and gender identity, on the other, on the use of learning styles. This was done

TABLE I. Factor loadings in a four-factor principal components analysis (Varimax rotation).

	ML	RL	PYL	UL
Processing strategies				
Deep processing				
Relating and structuring	0.74			
Critical Processing	0.74			
Stepwise processing				
Memorising ard rehearsing		0.70		
Analysing		0.71		
Concrete Processing	0.69			
Regulation strategies				
Self-regulation				
Learning process and results	0.75			
Learning content	0.73			
External regulation				
Learning process		0.72		
Learning results		0.62		
Lack of regulation				0.77
Mental models of learning				
Construction of knowledge	0.56			
Intake of knowledge		0.66		
Use of knowledge			0.77	
Stimulating education			0.48	
Co-operative learning				0.46
Learning orientations				
Personally interested	0.47			
Certificate orientated				
Self-test orientated			0.56	
Vocation orientated			0.53	
Ambivalent				0.80

*The scales of the ILS based on Vermunt (1993).

*ML is meaning-directed learning; RL is reproduction-directed learning; PYL is 'prove yourself' directed learning; and UL is undirected learning.

separately because in a single analysis the correlations between gender and gender identity are taken into account and the resulting partial regression coefficients would not answer our research questions. In both analyses, the independent variables age and subject are also added to assess their importance in the use of learning styles and to ensure that these effects do not distort the relations between gender, gender identity and learning styles. They are entered into the regression equations before entering gender and gender identity. In that way, the effects of gender and gender identity are adjusted for the effects of subject and age. In case of the analyses of variance, a similar adjustment is made by including age as a covariate and allowing for the interaction effect between subject and gender (identity).

In an ordinary regression approach, it is assumed that the error variances (of the students) are independent of each other. But in our nested data set of students within teachers, this assumption might be violated as the students are dependent on each other because of sharing the same teacher. In fact, the research question on the relation

TABLE II. The variation of the four learning styles in multi-level models

	meaning-directed		reproduction-directed		'prove yourself' directed		undirected	
	coefficient (SD)	*p*	coefficient (SD)	*p*	coefficient (SD)	*p*	coefficient (SD)	*p*
student level	0.9284 (0.072)	0.00	1.007 (0.073)	0.00	0.9320 (0.072)	0.00	0.9268 (0.072)	0.00
context level	0.0783 (0.042)	0.06	0 (0)	1	0.0557 (0.037)	0.14	0.0600 (0.037)	0.10

between learning styles and the teacher refers to the dependence of students. The learning styles of students of one teacher might be more similar compared to the learning styles of students of a different teacher. In that case, a multi-level approach is the most appropriate method to analyse our data set (Bryk & Raudenbush, 1992; Hox, 1994). Thus, the first step in analysing our data set consisted of checking the independence assumption. This will provide us at the same time with an answer to whether or not (and to what extent) the relations between gender (identity) and learning styles differ across teachers.

Although many researchers use the typology of androgyny, femininity, masculinity and undifferentiated in the analyses, it is not without criticism. In Ashmore (1990) it is shown that the typology results in a loss of information due to reducing two ordinal variables to a nominal variable. Moreover, it is impossible in the typology to assess the possible difference in correlations between learning styles and the masculine gender identity dimension, on the one hand, and the feminine gender identity dimension, on the other. This is the case because both femininity and masculinity incorporate both dimensions in the typology. These notions have prompted us to analyse the data in two ways. Firstly, the two dimensions are fitted in regression analyses in order to obtain information on the correlations of the masculinity and femininity dimensions separately. Secondly, the effect of the typology is analysed in analyses of covariance (ANCOVA) to describe possible differences in learning styles of androgynous, feminine, masculine and undifferentiated students.

Results

As stated above, the first step consists of checking the independence assumption. In Table II it is shown that in all four learning styles the amount of variance at the teacher level does not reach statistical significance. This means that the error variances are independent and the use of ordinary (single-level) multivariate methods is justified.

The research question on the relations between gender (identity) and learning styles and the context in terms of the teacher can be answered at this point. The finding of no variance at the teacher level means that learning styles of students do not vary according to the teacher in our sample. In other words, it seems that the context level in terms of the teacher is not related to the use of learning styles of students. Because no significant amount of variance at the teacher level appears, it makes no sense to try and explain this variance by gender or gender identity. The conclusion must be that gender differences in learning styles do not vary according to the teacher. Possible

TABLE III. Gender, age and subject: regression coefficients

	age	subject	gender	
	beta. (*p*)	beta. (*p*)	beta. (*p*)	*R*
meaning-directed	0.26 (0.00)	0.18 (0.00)	− 0.01 (0.92)	0.34
reproduction-directed	0.10 (0.06)	− 0.13 (0.01)	− 0.13 (0.01)	0.20
'prove yourself directed	0.03 (0.53)	− 0.10 (0.05)	− 0.05 (0.35)	0.11
undirected	− 0.20 (0.00)	0.02 (0.63)	0.11 (0.03)	0.25

relations between the subject and learning styles will be calculated in an ordinary regression approach.

The Meaning-directed Learning Style

Firstly, a regression analysis was performed on the meaning-directed learning style as dependent variable and gender, subject and age as independent variables. No significant coefficient of gender appears, but subject and age do show significant coefficients (see Table III). Apparently, women and men use the meaning-directed learning style to the same extent. The means of the factor scores in each subject show that this style is used most often in Dutch and less often in mathematics (see Table IV). Besides, older students use this style more often compared to younger students. An ANCOVA shows the same results: significant main effects for subject, $F(3,385) = 4.91$, $p = 0.00$, and age, $F(1,385) = 36.13$, $p = 0.00$, and, moreover, no interaction effect of gender and subject: $F(3,385) = 0.65$, $p = 0.58$.

Secondly, a regression analysis with gender identity, age and subject was performed (see Table V). The aim of this analysis was to assess the effects of the two dimensions of gender identity. Apart from the effects of age and subject, both dimensions of masculine and feminine gender identity show positive significant regression coefficients. This means that if students describe themselves in terms of stereotypical masculine attributes and behaviour, they use this style more often and the same holds true for students scoring high on the femininity dimension. The contribution of the masculinity dimension is larger compared to the femininity dimension (a beta of 0.20 compared to 0.10). The description of oneself as a typical male *and* a typical female—in other words, the description of oneself as androgynous—coincides with describing oneself as a meaningful learner. This finding is confirmed in an ANCOVA in which the gender typology (instead of the dimensions) was analysed. In this ANCOVA, the main effects were the gender typology and subject, their interaction effect was included, and age served as a covariate. The androgynous students use the meaning-directed learning

TABLE IV. The mean factor scores of subject

	Dutch	math	biology	history
meaning-directed	0.25	− 0.32	− 0.02	0.16
reproduction-directed	− 0.16	0.10	0.18	− 0.11
'prove yourself' directed	0.22	0.10	− 0.10	− 0.29
undirected	− 0.09	− 0.03	0.20	− 0.03

TABLE V. Gender identity, age and subject: regression coefficients

	age	subject	feminine gender identity	masculine gender identity	
	beta. (*p*)	beta. (*p*)	beta. (*p*)	beta. (*p*)	*R*
meaning-directed	0.30 (0.00)	0.20 (0.00)	0.10 (0.03)	0.20 (0.00)	0.41
reproduction-directed	0.09 (0.07)	− 0.13 (0.01)	0.13 (0.01)	− 0.14 (0.01)	0.24
'prove yourself directed	0.03 (0.53)	− 0.11 (0.03)	0.21 (0.00)	− 0.02 (0.67)	0.23
undirected	− 0.24 (0.00)	0.01 (0.89)	− 0.00 (0.94)	− 0.07 (0.16)	0.24

style most often, the undifferentiated students less often (see Table VI). The differences in means are statistically significant: $F(3,375) = 6.817$, $p = 0.00$. The interaction effect of gender identity and subject is not statistically significant: $F(9,375) = 0.347$, $p = 0.96$.

The amount of variance explained by gender is smaller compared to the amount of variance explained by gender identity. Apart from the difference in the multiple correlations (see Tables III and V), the ANCOVAs show this difference as well. Gender explains virtually nothing in the variance of the meaning-directed learning style, whereas gender identity explains 5%.

The Reproduction-directed Learning Style

Women more often use the reproduction-directed learning style compared to men, as is shown by the negative significant regression coefficient (see Table III). Besides, subject also shows a significant coefficient. It seems that the extent to which this style is used is also dependent on the subject the students are studying. In Dutch and history, the style is used less often compared to mathematics and biology (see Table IV). Age does not seem to have an effect on the use of this style. An ANCOVA shows no interaction effects of gender and subject: $F(3,385) = 0.341$, $p = 0.80$.

The feminine gender identity dimension correlates positively with the use of this learning style and the masculine gender identity dimension negatively (see Table V). In other words, people describing themselves as typical females seem to use this style more often. Describing oneself in terms of masculine stereotypes, on the other hand, implies the use of this style to a lesser extent. This can not be confirmed in the ANCOVAs on the factor scores of the groups in the typology. Although feminine identity students score highest and masculine gender identity score lowest (see Table VI), the typology does not explain a significant amount of variance in the use of the reproduction-directed learning style: $F(3,375) = 2.122$, $p = 0.10$.

TABLE VI. The mean factor scores of the gender identity typology

	undifferentiated	masculine	feminine	androgynous
meaning directed	− 0.23	− 0.06	− 0.04	0.28
reproduction-directed	0.00	− 0.17	0.22	− 0.07
'prove yourself' directed	− 0.14	− 0.25	0.11	0.22
undirected	0.07	0.02	0.00	− 0.06

The difference between the amount of variance explained by gender and gender identity in learning styles is very small (1% versus 2%), as is the difference in the multiple correlations (see Tables III and V). Thus, in the case of the reproduction-directed learning style, we must conclude that gender identity does not explain more variance compared to gender.

The 'Prove Yourself' Directed Learning Style

A nonsignificant coefficient shows that the 'prove yourself' directed learning style is used to the same extent by women and men (see Table III). Age is not important either, but the subject the students are studying does seem to have an effect on the use of this style. In Dutch and mathematics 'proving you can do it' seems to be more important compared to biology and history (see Table IV). Moreover, an ANCOVA resulted in a significant interaction effect of gender and subject: $F(3,385) = 2.890$, $p = 0.04$. The mean factor scores show that gender differences are largest if the students studying Dutch are considered: women score higher compared to men. In the remaining three subjects the mean gender differences are smaller.

The dimension of feminine gender identity shows a positive regression coefficient: students with a high score on the feminine stereotypes also score higher on the use of this learning style (see Table V). The dimension of masculine gender identity does not show a significant coefficient. The factor scores in the typology show that feminine and androgynous students use this style more often compared to masculine and undifferentiated students (see Table VI). The effect of the typology is statistically significant: $F(3,375) = 5.371$, $p = 0.00$.

Gender identity explains more in the use of this style compared to gender, as is apparent in their multiple correlations (see Tables III and V) and the amount of variance explained (gender identity 4% and gender 0%).

The Undirected Learning Style

Men are more often undirected in their learning compared to women (see Table III). Furthermore, age seems to have an important impact in predicting the use of the undirected learning style: younger students are more often undirected in their learning compared to older students. The subject the students are studying does not influence the extent to which this learning style is used. No interaction effect appears of gender and subject in ANCOVA: $F(3,385) = 1.097$, $p = 0.35$.

The dimensions of neither feminine nor masculine gender identity show significant regression coefficients (see Table V). Apparently, describing oneself in terms of feminine and masculine stereotypes is not related to the use of the undirected learning style. Accordingly, the differences in mean factor scores of the typology are not statistically significant either: $F(3,375) = 0.553$, $p = 0.65$.

Although gender differences are observed but no gender identity differences in the use of this style, the difference in amount of variance explained is very small (gender 1% and gender identity 0%, see Tables III and V for the multiple correlations).

Conclusions and Discussion

Research on gender-related learning processes produces a multitude of findings: gender differences in learning are small on average, but across studies quite different results are

observed (Severiens & ten Dam, 1994). In the present study, this heterogeneity of gender differences in learning is our central focus. Two possible interpretations are investigated. The first one concerns the educational context as an influential factor. In this study, two educational factors are considered: the teacher and the subject the students study. The second interpretation of the heterogeneity of gender differences concerns the construct of gender identity. This construct is added to the research design to reflect the point of view that the extent to which students perceive themselves as feminine or masculine may contribute to the learning styles they tend to use. Gender identity might offer a better insight into possible gender-related processes in learning compared to gender, because it takes the gendered attributes and behaviours students have learned through their lifetime into account, instead of 'just' their biological gender.

In order to answer the research questions in this study, the results will be summarised and interpreted. But first, we would like to mention the four learning styles as observed in our sample of adult secondary students. The important distinction between the meaning- and reproduction-directed learning styles or approaches to studying (Entwistle, 1981) is, just as in our study, generally observed in studies on student learning. The fourth style we observed in our sample could be interpreted as the undirected learning style, common to most studies using the present questionnaire (the ILS). The third learning style, which is usually interpreted as the application-directed style, could not be distinguished in our sample. However, the loadings on this factor were not difficult to interpret: we called it the 'prove yourself' directed style. It seems to be typical of adult secondary education: all students having failed for whatever reason at their initial attempt in regular education are now eager to show their ability to pass the exams. The present study is the first, to our knowledge, to investigate learning styles in this type of education and, in further research, the stability of this style should be examined.

The first research question concerned the relations between gender, gender identity and learning styles. In two learning styles, gender differences appear: the reproduction-directed learning style and the undirected learning style. Women more often use memorising and rehearsing strategies, they depend on the teacher or the school to organise their learning processes and define learning more often as taking in knowledge. Men, on the other hand, are more ambivalent as to why they are studying and lack a certain kind of regulation, more so than women. No gender effects were observed in the case of the meaning-directed and the 'prove yourself' directed learning styles. With the exception of the result that men are more ambivalent and more often lack a certain kind of regulation, these research findings correspond with those of Vermunt (1992).

Gender *identity* turned out to explain more variance compared to gender in learning styles. In two of the four learning styles, the amount of variance explained by gender identity is larger compared to the amount of variance explained by gender. In the other two learning styles, gender explains just as much variance as gender identity. Furthermore, we did not find similar learning styles among women and feminine students and men and masculine students (in terms of the typology), thus showing that gender identity and gender do not cover each other. The results are depicted in Table VII. Androgynous students score higher on the meaning-directed learning style. This means that if a student perceives herself or himself as a person with both typical masculine and feminine behaviour and attributes, that person also feels that he or she learns deeply and independently. These students are more often personally interested in the subject and they are learning in order to construct knowledge. Differences between androgy-

TABLE VII. Relations between gender identity and learning styles

	typology	femininity dimension	masculinity dimension	gender
meaning-directed	androgynous highest	+	+	n.s.
reproduction-directed	n.s.	+	−	women higher
'prove yourself' directed	androgynous, feminine highest	+	n.s.	n.s.
undirected	n.s.	n.s.	n.s.	men higher

n.s.: not statistically significant.

nous, masculine, feminine and undifferentiated students in the use of the reproduction-directed learning style are not statistically significant, even though the femininity and masculinity dimensions are significantly related to the use of this style. Describing oneself as using stepwise processing strategies, leaving the regulation to an external source and defining learning as a matter of taking in knowledge, is positively related to the femininity dimension and negatively to the masculinity dimension. The 'prove yourself' directed learning style is related to the femininity dimension. Both the androgynous students and feminine students (in the typology) are more often interested in using the knowledge they obtain, expect to be stimulated by education, go to school because it involves showing they are able to pass the tests and have an interest in learning because of the possibilities it creates in terms of practising a vocation. Gender identity is not related to the undirected learning style. Whether or not students know for what reasons they are at school, whether or not they lack regulation or are interested in studying together with other students, has nothing to do with their gender identity.

Cook (1985, p. 119) concludes that "recent research indicates that androgynous persons tend to receive the most favourable scores or classifications on various indices of psychological development" (e.g. on self-esteem or mental health). Although, to our knowledge, no studies have been performed on gender identity and learning styles, a few discussed academic performance and related topics. In accordance with Cook's conclusion, androgynous students score highest on academic performance (Olds & Shaver, 1980) and efficient use of intellectual ability (Baucom, 1980). Our finding of a higher score of androgynous persons on the use of the meaning-directed learning style seems to fit the more general observations on androgynous persons. Although, in some instances, a reproduction-directed style might lead to higher grades, it is hard to deny that the meaning-directed learning style is usually more desirable. Being critical, relating various aspects of the learning content and self-regulation are clearly positive characteristics of any student. This style has also been found to result in higher grades, both in higher education (Vermunt, 1992) and in secondary education (Roosendaal & Vermunt, 1993).

Even though androgynous persons usually score higher on different positive characteristics, the correlation of the masculinity dimension with these characteristics is often larger compared to the correlation of the femininity dimension. This is exactly the case when the meaning-directed learning style is considered. In the context of learning, this 'good' learning style is associated with androgyny, but the masculinity dimension shows a greater correlation. In other words, the masculine attributes and behaviours, more

than the feminine ones, can be related to the use of the meaning-directed learning style—a learning style which proved to be effective in terms of study results. However, these typical masculine attributes and behaviours (e.g. ambitious and enterprising, reading the economic pages in the paper or discussing political problems with peers) are only effective in the context of androgyny. In conclusion, perceiving oneself in terms of typical masculine attributes and behaviours without, however, losing sight of or dismissing the typical feminine aspects of gender identity can be related to the use of the meaning-directed learning style.

It is important to note that the finding of a relationship between gender identity and learning styles does not necessarily imply a causal relationship. An underlying variable might cause the relationship. Examples of such a variable are analytical ability, or, as stated before, efficient use of intellectual ability. These variables may both be linked to the use of the meaning-directed learning style and androgyny at the same time and, thus, generate their relationship. Clearly, further research into this subject is needed to investigate possible underlying variables which influence the relationship between gender identity and learning styles.

Even though the link between *age* and learning styles is not of central theoretical importance in our study, the enormous range in ages common in adult secondary education may show some interesting effects. It turned out that older students more often use the meaning-directed learning style and younger students the undirected learning style. Both Watkins and Hattie (1981) and Vermunt (1992) observed a similar effect in higher education in the case of the meaning-directed learning style. Thus, the findings in our study confirm these observations on age differences in learning styles.

The second research question concerned the impact of educational context on the relations between gender (identity) and learning. In the multi-level analyses, it was shown that learning styles do not vary at the second level; learning styles of students do not differ according to their teachers. Subject, on the other hand, does seem to be an important factor in the use of learning styles. The extent to which the meaning-directed, the reproduction-directed and the 'prove yourself' directed learning styles are used depends on the subject the students are studying. In Dutch the meaning-directed and 'prove yourself' directed learning styles are used most often, whereas in biology students most often use the reproduction-directed learning style. In one case, an interaction effect of gender and subject was observed: women studying Dutch use the 'prove yourself' directed style more often compared to men, whereas the observed difference between women and men in the other three subjects are smaller. Apart from this interaction effect, the other relations between gender, gender identity and learning styles did not differ across subjects or teachers. Thus, the impact of the aspects of the educational context, as investigated in the present study, on the gender-related use of learning styles could only be shown to a small extent.

This does not necessarily mean, however, that contextual factors are not important. It might be that, for example, learning tasks within subjects show a different set of relationships between gender, gender identity and learning styles. Or, looking outside the area of gender and learning, the type of assessment is supposed to influence the learning style students use according to Entwistle and Ramsden (1981) and Speth and Brown (1990). The large variation in gender differences across studies, as described earlier, suggests an influence of the context in which the studies were performed. Therefore, the search for influential contextual factors should continue in order to demonstrate the role of education in producing gender differences. This is important because an understanding of the impact of education on gender differences in learning

could point out the possibilities to bring about a process of change and create gender equality in educational practice.

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NOTE

[1] The distribution of the scales of the ILS were inspected for normality: a few outliers were removed from the sample, only very slight departures from normality remain.

The independent variable 'subject' consists of four categories. Because this variable plays an important role in the present study, the homogeneity of the covariance matrices was tested. The test produces a significant Box's *M* and, consequently, it must be concluded that the matrices are unequal to each other. This means that in the separate 'subject' groups' learning styles might take on a different form. A meaning-directed learning style in the groups of students studying mathematics might consist of different scales compared to the meaning-directed learning style in the 'history' group. Thus, analyses on the complete sample might give a misleading view of the relationships in our data set. But because the test statistic is quite sensitive to non-normality and also very powerful (*SPSS/PC+, Professional Statistics Version 5.0*, 1992, p. 41), we decided to compare the learning styles and their scales in the four subject groups. Separate factor analyses for each subject resulted in four separate scale constructions. In other words, similar to the factor analyses used to define the four learning styles of the whole sample (see the section on scale construction), we now obtained a different solution in each subject. Comparing the factors to each other and the 'overall' factors showed that similar learning styles were obtained. There were a few differences, but on the basis of the similarity of these factor patterns, we decided to analyse the complete data set despite the Box's *M* test result.

The covariance matrices of women and men resulted in a nonsignificant Box's *M*, so we can safely conclude the factor patterns for women and men are similar.

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